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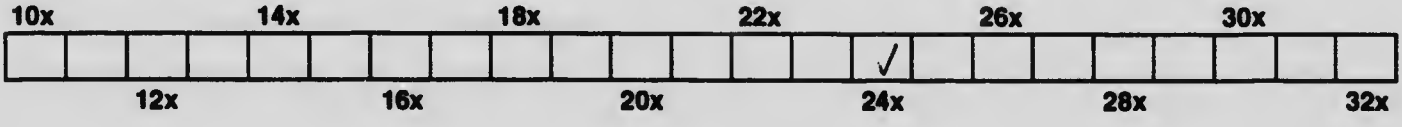
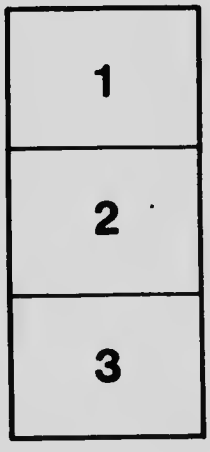
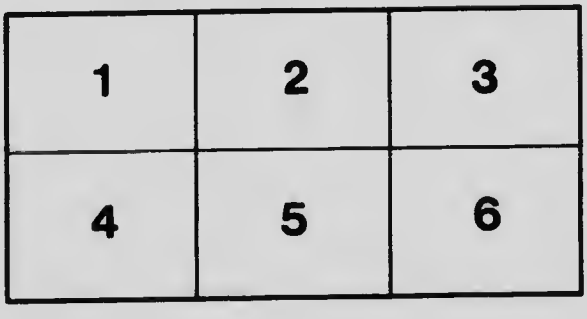






BULLETIN 268] [JANUARY, 1919

Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

FARM CROPS

Results of Experiments at the Ontario Agricultural College

C. A. ZAVITZ.

INTRODUCTION.

Within the past few years the farmers of Canada have worked hard to secure surplus food materials to be shipped to the Allies. The present demand is as great or even greater to furnish food to millions of people in Europe, many of whom are at the point of starvation.

Field Husbandry Building.

In the United States Year Book for 1916 an article entitled "A Graphic Summa of World Agriculture" contains some interesting information. For three years previous to the war, viz., 1911, 1912 and 1913, estimates were made regarding production of food materials from farm crops in the principal agricultural countries of the world. The following table is based on the information gleaned from this article:—

COMPARATIVE ESTIMATES OF DIFFERENT COUNTRIES ON THE BASIS OF 100.

Countries.	Areas in Farm Crops.	Areas in Farm Crops per Capita.	Production per capita of Food Materials from Farm Crops.
Canada	11.6	67.1	100.0
Argentina	19.1	100.0	80.0
United States	100.0	46.0	64.3
Australia	4.6	39.5	35.0
German Empire	20.6	13.1	30.2
Austria-Hungary	19.5	17.1	29.8
France	18.6	19.7	25.4
Russian Empire	86.5	21.0	24.7
Italy	16.1	18.4	13.6
India (British)	68.8	11.8	11.0
United Kingdom	6.0	5.2	8.0

Owing to the lack of available statistics the Chinese Empire is not included in the above list.

It will be seen that the United States comes highest in area of farm crops, and that Argentina comes first in area of farm crops per unit of population. It will also be seen that Canada produced per unit of population more food materials obtained from farm crops than any of the other principal countries of the world. It is the amount of surplus over home consumption in the production of food materials which is the important factor in supplying the real necessities of life to the starving populations of other countries. This being true, Canada occupies a unique position in furnishing food materials from farm crops for export, as indicated in the tabulated results here presented.

FIELD EXPERIMENTAL WORK.

The experimental grounds at the Ontario Agri[illegible] College, under the direction of the Field Husbandry Department, consi[illegible] seventy-five acres of land divided into approximately two thousand five [illegible]ots, and on which experiments are being conducted with varieties of gra[illegible], tuber, grass, clover, fodder, silage, and other crops; with artificial, green and barnyard manures; with methods of cultivation, selection of seed, dates of seeding, mixtures of grains, pasture grasses, etc. In addition the Department directs the co-operative experimental work on about four thousand farms throughout the Province.

A greater portion of the experimental grounds has a gentle slope towards the south-west, and a smaller area has a slope towards the north-east. The soil is what might be termed an average clay loam. The lower portions of the land contain rather more vegetable matter than the higher sections. The greater portion of the land has a four years' rotation, the rotation being: First, grain crops; second, cultivated crops; third, grain crops; and fourth, pasture. This is a special rotation particularly well suited to the experimental work as carried on at the College. About one-quarter of the land is manured each year with twenty tons of farmyard manure per acre: thus most of the land receives an application of farmyard manure once every four years. The manure is applied previous to the cultivated crops.

No commercial fertilizers are used except in distinct fertilizer experiments, and these occupy a comparatively small area each year. Within the past sixteen years one green crop has been ploughed under on each section of the grounds. The plots vary in size according to the requirements of the different experiments, and the yields per acre are determined from the actual yields of the plots in every instance. All of these experiments are conducted with the greatest care, and for several years in succession in order to secure strictly accurate results. These experiments deal with the crops grown on fully nine-tenths of the cultivated lands of Ontario. An immense amount of thought and care is required in planning, supervising and examining these plots, and in studying, comparing and summarizing the results for presentation in reports, bulletins, newspaper articles, and lectures.

There are but few lines of work in which it is absolutely necessary to use so much care in the details. It is also exceedingly important to repeat the experiments for several years in order to get results which are as reliable as possible. All of our field experiments are conducted for at least five years before they are dropped, and many of them are continued for a much longer period of time. For the results of some of the tests which were carried on for five or more years previous to 1918 the reader is referred to former reports and bulletins. The results of some of the experiments which have as yet been conducted for one or two years are held over until the test can be carried through a longer period of time. As different seasons vary so much in temperature, rainfall, etc., the average results of experiments continued for several years are of much greater value than those secured from one or two seasons' work. Owing to the great care exercised in the work, and the number of years through which the experiments are continued, we are able to present the results with much confidence in their reliability and in their practical value.

Western Section of Experimental Grounds.

Field Experiments by Farmers.

During the past thirty-three years, a large amount of co-operative experimental work has been conducted throughout Ontario through the medium of the Ontario Agricultural and Experimental Union. Thousands of farmers have carried on this work successfully in their own fields. The material has been forwarded from the College and full details have been given regarding the operations for each experiment. The work was started in 1886 with only 12 experimenters. It has increased gradually and substantially until, within the last few years, from three to five thousand farmers have taken up the work each year. There are now fully thirty distinct and separate spring experiments, and also six experiments for the autumn. The experimenters make their choice from these two lists. The development of this work can be understood to a certain extent by a knowledge of the increase in the number of experimenters in agriculture for the past thirty-three years. The following figures give the average annual number of farmers who have been acting as experimenters on their own farms, the results being presented in three periods of **Eleven Years** each:—

Periods.	Years.	Average Number of Experimenters per Annum.
1886-1896..... ..	11	720
1897-1907.....	11	3,386
1908-1918..... ...	11	4,288

It is impossible to estimate the great good which has been brought about in various ways through the medium of the co-operative experimental work. The principal conclusions from the carefully conducted experiments carried on throughout the Province are presented and discussed each year at the annual meeting of the Experimental Union. Any interested farmers of Ontario are always welcome to this gathering. The proceedings of the annual meeting with the results of the co-operative experiments are printed in the annual report of about one hundred pages, and some 32,000 copies are issued. The proceedings of the last meeting were printed as Bulletin No. 260, in addition to the Annual Report, the Bulletin being issued early in the spring so that the information could reach the farmers before the time of spring seeding. Either or both of these can be obtained by writing to the Department of Agriculture, Parliament Buildings, Toronto.

Weather Conditions.

As it is important for a proper understanding of the results of experiments with farm crops to have a knowledge of the weather conditions in the locality in which the experiments have been conducted, the amounts of rainfall and the mean temperature in the six months of the growing season in each of the past **Nineteen Years** are here presented. These have been carefully determined in each of these years by the Department of Physics at the College, from which department we have received the information.

INCHES OF PRECIPITATION DURING THE SIX GROWING MONTHS.

Year.	April.	May.	June.	July.	August.	September.	Total.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
1900	1.69	1.03	4.47	3.05	.87	1.52	12.63
1901	2.24	3.26	1.53	4.07	3.51	2.45	17.06
1902	2.43	1.67	3.06	6.43	2.18	3.58	19.35
1903	2.69	2.44	3.05	2.67	3.47	1.48	15.80
1904	2.10	3.01	2.86	4.99	3.88	2.80	16.64
1905	1.82	3.89	3.24	4.60	1.98	2.85	16.36
1906	1.44	2.71	4.06	4.65	2.13	2.49	17.46
1907	1.66	2.64	1.11	1.92	.62	2.87	10.82
1908	1.33	3.47	3.21	3.25	2.75	.73	14.74
1909	3.60	3.43	1.33	4.54	.89	.86	14.65
1910	3.13	2.75	.78	2.09	3.18	3.00	15.02
1911	1.67	1.64	.89	1.95	2.53	3.42	12.10
1912	1.14	5.64	1.51	2.53	6.07	3.08	16.67
1913	3.53	1.37	2.03	3.26	2.88	1.49	14.56
1914	2.86	2.04	2.76	1.23	4.21	1.96	15.06
1915	2.23	2.24	2.27	5.87	6.16	3.92	22.66
1916	3.53	4.41	4.46	1.21	1.68	1.83	17.12
1917	3.36	3.29	6.40	7.54	3.28	1.41	25.28
1918	2.38	4.22	4.56	1.47	5.18	4.06	21.67
Average 19 years.	**2.36**	**2.90**	**2.62**	**3.54**	**3.02**	**2.41**	**17.05**

The record of the rainfall for the past nineteen years forms interesting material for study. A bulletin was issued on "Farm Crops" giving results of experiments up to the autumn of 1914. In that bulletin the amount of rainfall for the six growing months was given for each of fifteen years finishing with 1914. Since that time we have the record of rainfall for the six growing months in each of four years, from 1915 to 1918 inclusive. The following table gives the average amount of rainfall for each of the two periods:—

Period.	April.	May.	June.	July.	August.	September.	Total.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
1900–1914 (15 years)	2.22	2.73	2.39	3.40	2.74	2.32	15.82
1915–1918 (4 years)	2.88	3.54	4.42	4.02	4.08	2.81	21.74

It will be seen that the amount of rainfall during the [illegible] the growing season of the last four years has been exceptionally heav[illegible]verage amount being about one-third greater than that for the fifteen ye[illegible]revious. The total rainfall for the growing season at the Ontario Agricultural C[illegible]lege was from 1.3 to 9.5 inches greater per season in the last four years than for th[illegible] average season of the fifteen years previous. For the fifteen years from 1900 to 19[illegible] inclusive, 12 per cent. of the individual months had from 4 to 6.4 inches of r[illegible]nfall, and for the four years from 1915 to 1918 inclusive, 42 per cent. of the ind[illegible]al months had from 4 to 7.5 inches of rainfall. The large amount of precipi[illegible] occurred in July and August in 1915, in May and June in 1916, in June and Ju[illegible] in 1917, and in May, June, August and September in 1918. Whether or not [illegible]

discharge of tremendous amounts of high explosives in Europe had any influence on the amount of rainfall at Guelph, Ontario, is a problem for the meteorologists to try and solve.

The following table gives the average temperatures at the Ontario Agricultural College during each month of the growing season in each of the past **Nineteen Years**:—

Year.	April.	May.	June.	July.	August.	September.	Average 6 months.
1900.....	44.2	55.2	64.6	68.4	71.7	64.5	61.4
1901.....	45.8	53.8	64.3	73.0	65.4	60.7	60.5
1902.....	39.7	52.8	57.8	68.7	68.2	59.3	56.9
1903.....	42.2	56.6	60.1	69.5	62.5	63.1	59.0
1904.....	34.0	53.3	62.5	65.7	64.0	58.2	56.3
1905.....	41.2	52.8	62.6	67.7	63.9	61.6	58.3
1906.....	44.2	55.2	65.2	67.7	69.5	63.6	60.9
1907.....	38.7	48.6	61.4	66.4	68.7	62.7	57.8
1908.....	38.8	55.9	65.4	69.5	65.2	64.5	59.9
1909.....	39.3	50.6	64.9	68.2	67.7	57.9	58.1
1910.....	45.9	51.5	63.3	69.5	66.3	56.1	58.8
1911.....	40.3	61.7	65.4	71.0	71.6	59.7	61.6
1912.....	41.3	51.7	62.4	67.1	61.5	61.8	57.6
1913.....	43.9	52.5	63.4	67.6	67.0	57.4	58.6
1914.....	39.7	56.6	62.0	68.6	66.3	58.3	58.6
1915.....	48.4	49.6	60.1	65.8	63.6	61.9	58.2
1916.....	42.6	52.8	56.2	73.8	69.0	58.0	58.7
1917.....	40.1	47.4	59.9	69.0	64.9	55.2	58.1
1918.....	42.9	58.2	60.6	67.5	69.5	53.9	58.8
Average 19 years .	**41.7**	**53.5**	**62.2**	**68.7**	**66.4**	**59.9**	**58.7**

It will be seen from a study of the data given under weather conditions that for the months of the growing season of each of the past four years, the mean temperature has been about normal, but the rainfall has been exceptionally high.

Rotation of Crops.

The cropping of the College farm follows mainly along a four year rotation, as follows: One year, cultivated crops; one year, grain crops; and two years, hay and pasture. In our experimental grounds, it is necessary to grow a comparatively large amount of grain in order to meet the requirements of the various tests. The main rotation used, therefore, on the land devoted to the testing of varieties, dates of seeding, methods of cultivation, etc., extends over four years and is as follows: First year, cultivated crops; second year, grain crops; third year, pasture; and fourth year, grain crops. In another section of twenty-five acres in the experimental grounds a three-year rotation is conducted as follows: First year, cultivated crops; second year, grain crops; and third year, leguminous crops.

It is highly important that each person adopt on his own farm the rotation of crops which is likely to give the best results to meet the conditions of the farm and the requirements of the system of farming. While it is true that no one rotation is the best under all conditions, it is equally true that certain underlying principles should be applied as much as possible in each rotation. The rotation should be so arranged that the crop of each year should not only be the suitable crop for that season, but would also in some way or other for a preparation for

the crop of the following year. A crop such as corn, oats, or potatoes when carefully cultivated assists the following crop by the destruction of weeds and of weed seeds and by liberating plant food. The grain crops should be sown in such a way that they not only furnish good results themselves but make good nurse crops for seeding with grasses, clovers, or alfalfa. The leguminous crops, such as the clover and the alfalfa, not only furnish a large amount of nutritious feed, but also improve the mechanical condition of the soil, and add to the land some of the free nitrogen of the atmosphere in the root residue, thus improving the land for the crops following. Any person who has not given the subject of crop rotation his careful thought and attention has not lived up to his opportunities in making use of one of the best features in high crop production from an economical standpoint.

Central Section of Experimental Grounds.

Standard Weights per Bushel and per Bag.

The standard weight per bushel of turnips, carrots, and beets was changed from 60 to 50 pounds in January, 1915. In giving yields per acre, the standard weights are used in all instances in this bulletin unless special reference is made to bushels by measurement.

The following are at present the legal standard weights per bushel within the Dominion of Canada:—

Products.	Pounds.	Products.	Pounds.
Blue Grass seed	14	Onions	50
Oats	34	Indian Corn	56
Hemp seed	44	Rye	56
Parsnips	45	Flax seed	56
Barley	48	Artichokes	56
Buckwheat	48	Wheat	60
Timothy seed	48	Peas	60
Turnips	50	Beans	60
Beets	50	Clover seed	60
Carrots	50	Potatoes	60

The following are at present the legal standard weights per bag within the Dominion of Canada:—

Article.	Weight in Dominion Standard Pounds.
Artichokes	84
Beets	75
Carrots	75
Onions	75
Parsnips	65
Potatoes	90
Turnips	75

Any person who sells or offers for sale by the bag any of these articles which do not contain at least the number of Dominion standard pounds stated in the foregoing table is liable on summary conviction to a penalty not exceeding $25 for the first offence, and, for each subsequent offenec, to a penalty not exceeding $50.

Copies of the Act and of the Amendments may be obtained from the Minister of Trade and Commerce, Ottawa, Ontario.

Continuous Growing of Farm Crops without Change of Seed.

We have had in our experimental grounds twenty-eight varieties of oats, barley, spring wheat and winter wheat which have been grown without change of seed from an outside source for twenty-four to thirty years. Some of these are common varieties, such as, the Common Six-rowed barley, Dawson's Golden Chaff winter wheat, Red Fife and Wild Goose spring wheat, etc. Other varieties are not quite so well known in Ontario, such as, Waterloo oats, Oderbrucker barley, Herison Bearded and Medeah spring wheat. The twenty-eight varieties included in this experiment covered a wide range of characteristics and should be suitable for a test of this kind. The results are interesting.

In certain localities in Ontario, it is still considered necessary by some farmers to change the seed quite frequently from one soil to another. The question of a frequent change of seed has been discussed and argued for many years. There are some strong advocates for a frequent change of seed, while other men are just as strong in advocating the continuous growing of varieties on the same farm for a number of years, and especially if they have choice varieties and have been careful in the selection of seed from year to year. A large number of practical farmers are realizing more and more the fact that in very many cases they are able to grow the same varieties for a considerable period of time without any change of seed, providing proper care is taken in growing varieties suitable for the soil, in the careful selection of the seed, and in the cultivaiton of the land. In the experiments which have been conducted at Guelph within the past thirty years, care has been taken to have the crops grown under as nearly normal conditions as possible. The soil on which these crops have been grown has changed but little in fertility, and no commercial fertilizers were used on the land. They simply fitted into the four-year rotation, which is considered by practical farmers to be a more severe rotation than the one used on the College farm, as in our experimental grounds in the four-year rotation, two crops of grain and one cultivated crop are removed from the land, the crop in the other year being used for pasture. No plant selection was used in this test, but good seed was sown each year.

The following table gives the average annual yield per acre of each variety for the last **Five Years** in comparison with that for the whole period including 1918:—

Crop.	Length of Whole Period. (Years)	Variety.	Average Yield per Acre (bushels). Five Years, 1914–1918.	Average Yield per Acre (bushels). Whole Period including 1918 24 to 30 Years.
Oats	30	Siberian	87.7	89.4
		Probsteier	89.4	86.4
		Oderbrucker	87.1	85.9
		Waterloo	84.8	84.8
		Bavarian	90.7	84.1
		Joanette	75.1	83.3
		Egyptian	78.4	76.4
		Black Tartarian	72.8	70.1
Six-rowed Barley	29	Mandscheuri	63.2	68.3
		Oderbrucker	59.3	62.3
		Common Six-rowed	47.2	57.7
		Mensury	49.7	56.8
Two-rowed Barley	29	French Chevalier	58.5	56.1
Hulless Barley	29	Black Hulless	44.9	44.3
Winter Wheat	24	Dawson's Golden Chaff	37.7	48.2
		Early Red Clawson	37.3	44.2
		Bulgarian	37.3	40.6
		Treadwell	33.3	39.1
Common Spring Wheat	28	Saxonka	40.2	33.7
		Red Fife	37.1	32.6
		Pringle's Champion	40.3	32.4
		Red Fern	38.2	32.4
		White Russian	37.8	32.0
		Herison Bearded	40.3	31.8
		Colorado	35.7	29.6
Durum Spring Wheat	28	Wild Goose	41.5	37.6
		Medeah	36.1	33.4
		Sorentina	37.0	32.4

Of the twenty-eight varieties included in this test, only ten varieties gave a lower average yield per acre for the last five years than for the whole period of from twenty-four to thirty years. It will be seen that all varieties of spring wheat, durum wheat, hulless barley, two-rowed barley, and all of the varieties of oats except two have given a greater average yield per acre in the past five years than in the whole period in which they have been under test. The varieties of winter wheat and barley and the Siberian and the Joanette varieties of oats have given a lighter yield in the shorter period. It will be remembered that the winter wheat crop has been exceptionally light in Ontario in each of the past two years, and especially is this true in the season of 1918. Owing to severe winter conditions, the winter wheat was a partial failure in each of these two seasons. The weather conditions were rather unfavorable for barley production in Ontario in both 1914 and 1916. The season of 1918 was exceptionally favorable for the production of spring wheat throughout the Province.

The average results for the twenty-eight varieties show that the yield per acre has been slightly higher during the past five years than for the whole period of twenty-four to thirty years. The results of this experiment are very suggestive and show that varieties of grain crops may be grown in Ontario over a long period of time without change of seed and with very satisfactory results if care is exercised in the use of seed of good quality.

Comparative Results from Different Classes of Farm Crops.

In each of the past eighteen years two leading varieties of oats, barley, spring wheat, field peas, spring rye, hulless barley and emmer have been grown in our experimental grounds under uniform conditions of soil and climate. The object of this experiment has been not so much to compare one variety with another, as to secure definite information regarding the relative productiveness of different classes of farm crops. It is strange but nevertheless true that but little definite work has been done at Agricultural Experiment Stations in comparing in this positive and comprehensive way the relative productiveness of our most common grains. As the experiment was conducted in duplicate each year, it will be seen that we now have the results of 36 separate and distinct tests conducted in the eighteen-year period with these seven classes of farm crops. In some years the experiment was conducted on high land, in other years on low land, and in others upon land which had a gentle slope; in some seasons facing the north-east and in others the south-west. On no occasion was this experiment conducted on particularly heavy or especially light soil, but on loam which varied somewhat from year to year, from fairly light to medium heavy. The results of this experiment are very interesting.

In order to add to the value of the results of this experiment, we have used the tabulated results of the digestible constituents of the different classes of crops as presented in the fifteenth edition of the book entitled "Feeds and Feeding," written by Henry and Morrison, and printed in 1915. By multiplying the yields per acre by the percentage of digestible constituents given for each crop, the amounts of digestible constituents per acre have been worked out. When these constituents are added, it gives the total amount of digestible constituents per acre for each crop. It should be understood that the digestible fat is usually estimated as being 2.25 times as valuable as an equal amount of digestible carbo-hydrates. The following table gives the average annual results of the 36 distinct experiments conducted within the past **Eighteen Years**:—

Class of Crop.	Straw (tons.)	Grain (lbs.)	Pounds of Digestible Constituents in Grain.			
			Crude Protein.	Carbo-hydrates.	Fat.	Total.
Barley	1.74	2673	240.6	1785.6	42.8	**2069.0**
Emmer	1.97	2548	242.1	1610.3	43.3	**1895.7**
Oats	2.30	2591	251.3	1349.9	98.5	**1699.7**
Wild Goose Spring Wheat	2.16	1955	215.1	1255.1	31.3	**1501.5**
Rye	2.17	1760	174.2	1203.8	21.1	**1399.1**
Field Peas	1.49	1815	344.9	1012.8	10.9	**1368.6**

It will be observed from the foregoing table that in the average of thirty-six separate tests covering a period of eighteen years barley gave the largest weight of grain and oats the largest weight of straw per acre. Rye gave the lowest yield of grain and field peas the lowest yield of straw. It will also be observed that for the eighteen-year period barley has given an increase over the oats of 82 pounds of grain per acre per annum.

In digestible food constituents per acre field peas was the highest in crude protein, barley in carbo-hydrates, and oats in fat. In total digestible constituents barley surpassed the oats by an average of 369 pounds per acre per annum.

The Bureau of Industries, located in the Parliament Buildings at Toronto, has gleaned statistics throughout the Province regarding crop production in each of the past thirty-six years. The results are given annually in bulletins and reports and furnish some interesting material for study. Grains are reported in bushels per acre. By multiplying the average number of bushels per acre by the standard weight per measured bushel of each class of grain a more definite comparison can be made. Again, by multiplying the pounds of grain per acre by the percentage of digestible constituents of each, the amount of digestible material per acre of each class presents even a more accurate determination of the real value of the feed produced per acre from the different classes of grain crops grown in Ontario. As a basis of study the results for the estimated crops of Ontario have been worked out in a similar way to those presented in the foregoing table in connection with a distinct experiment conducted at the College. The following table gives the estimated annual yields of grain per acre over a period of **Thirty-Six Years,** and in the case of each of eight classes of crops and the amount of digestible constituents in each instance:—

Class of Crop.	Grain (lbs.)	Pounds of Digestible Constituents in Grain.			
		Crude Protein.	Carbo-hydrates.	Fat.	Total.
Barley	1349	121.4	901.1	21.6	**1044.1**
Fall Wheat	1278	111.2	866.5	17.9	**995.6**
Field Peas	1146	217.7	639.5	6.9	**864.1**
Oats	1217	118.0	634.1	46.2	**798.3**
Wild Goose Spring Wheat	966	88.9	649.2	15.4	**753.5**
Spring Rye	924	91.5	632.0	11.1	**734.6**
Beans	978	183.9	501.7	7.8	**693.4**
Buckwheat	974	78.9	484.1	24.4	**587.4**

As emmer has been grown in Ontario for a comparatively short time and only to a limited extent it is impossible to give the results of this crop for the Province. Fall wheat, beans and buckwheat are not included in the experiment conducted at the College.

It will be noticed that barley gives the greatest weight of grain per acre throughout Ontario of the small grains grown during the past thirty-six years as based on the reports of the Ontario Bureau of Industries. As will be seen, barley has surpassed oats by an average annual yield per acre of 132 pounds of grain and of 245.8 pounds of total digestible matter.

In the two previous tables the grains occupy the same relative order in the production of total digestible food material with the single exception that the estimated yield of field peas throughout Ontario for the thirty-six year period stands higher in the list than the yield of field peas in the experiments at the College extending over a period of eighteen years.

Selection of Seed Grain.

An interesting and valuable experiment has been carried on at the College in which different selections of seed of various classes of grain have been tested from

five to nine years. For this experiment seed was taken each year from a general crop of grain grown either on the College farm or in the Experimental Department. It will be understood that whatever difference there is from the influence of the selection of seed that difference is attributed entirely to the careful selection of the seed for the separate years in which the tests were made. The results show the influence of one year's selection, and are, therefore, of special interest to the practical farmer. For the large plump seed none but well developed grains were selected; for the small plump sample the grains selected were of a uniform character; and for the shrunken sample none but shrunken grains were used, the last selection being made regardless of the size of the kernels. The sample of broken grain in the case of barley, and also of rye, contained nothing but grains which had been broken crosswise; split grain, in the case of winter wheat, contained nothing but grains which were broken lengthwise; and split seed, in the case of peas, contained peas which were split and not broken. The grain from which these selections were made was all threshed with a grain separator, and the splitting and the breaking of the grains were, therefore, done in the usual process of threshing. In the selection of large, plump seed, one-half pound was carefully weighed from each class of grain. The number of large, plump seeds of each kind of grain was then counted, and a corresponding number was taken of the medium sized grain, the small, plump grain, and the shrunken grain. In the case of the broken or split grain, twice the number of the half kernels, as compared with the whole grains, were used. The different selections were carefully sown upon plots of similar size. The following table gives the average yearly results of each selection made from six different classes of grains:—

COMPARATIVE RESULTS FROM SEED SELECTIONS WITH GRAIN.

Class of Grain.	Selections.	Number of Years Tests Repeated.	Weight per Measured Bushel (pounds.)	Average Yield per Acre per Annum.	
				Straw (tons.)	Grain by Weight (bushels.)
Oats	Large Seed	7	33.2	1.9	62.0
	Medium-sized Seed	7	32.2	1.8	54.1
	Small Seed	7	31.8	1.8	46.6
Barley	Large Plump Seed	6	49.5	1.5	53.8
	Small Plump Seed	6	48.8	1.5	50.4
	Shrunken Seed	6	49.1	1.4	46.0
	Broken Seed	6	48.6	1.3	43.2
Spring Wheat	Large Plump Seed	8	59.1	1.4	21.7
	Small Plump Seed	8	58.3	1.3	18.0
	Shrunken Seed	8	56.9	1.2	16.7
Spring Rye	Large Seed	5	53.3	2.0	26.0
	Medium-sized Seed	5	53.3	2.0	24.4
	Small Seed	5	53.5	1.9	22.3
	Broken Seed	5	52.8	1.6	16.9
Winter Wheat	Large Plump Seed	6	59.4	2.6	46.9
	Small Plump Seed	6	59.2	2.2	40.4
	Shrunken Seed	6	59.1	2.1	39.1
	Split Seed	6	54.2	.6	9.3
Peas	Large Seed	6	56.3	1.3	28.1
	Small Seed	6	56.3	1.1	23.0
	Sound Seed	9	58.1	1.4	29.2
	Split Seed	9	57.9	.6	10.2

One year's selection of seed grain has a marked influence on the resulting crop. In every instance, the large plump seed gave a greater yield of grain per acre than medium-sized, small, plump, shrunken or broken seed. In the average of the six classes of grain the large plump surpassed the small plump in yield of grain per acre by 19 per cent., and, in the average of the three classes of grain, the plump seed gave a yield over the shrunken seed of 20 per cent. It should be understood that equal numbers of seed were used in this experiment. The results throughout

Growth from Seed Oats of Different Selections.

show that a large plump seed will produce a larger, more vigorous and more productive plant than is produced from a small plump or from a shrunken seed. Other experiments are now being conducted in which different selections of seed are used at different rates of seeding. In all experiments the results are in favor of sound, plump seed of good size for grain production.

Influence of Root Seed Selection.

A large amount of experimental work has been conducted at the College within recent years to determine the influence of different selections of root seed upon the resulting crop. Four tests were made annually with the different selections of seed of the field roots. Duplicate experiments were conducted in which the seeds of the different selections were planted separately, and duplicate experiments were also conducted by planting three large, five medium, and eight small seeds at each place where it was desirable for a root to grow. The plants were thinned to one at each place, and at equal distances apart. When the roots were harvested the yields of the duplicate tests of each method were averaged. The following table gives average results of the duplicate test made by means of each of two methods of comparison in order to ascertain the amount of influence of the size of root seeds on the yield of the roots produced:—

Method of Planting.	Roots.	Number of Years' Tests.	Yield of Crop per Acre.		
			Large Seed.	Medium Seed.	Small Seed.
			Tons.	Tons.	Tons.
Plots in which equal numbers of seeds were planted separately	Mangels	5	31.19	27.02	18.57
	Sugar Beets	5	23.25	21.32	13.48
	Swede Turnips...	5	15.35	12.63	7.03
	Fall Turnips	5	26.72	22.00	13.55
	Field Carrots	5	22.32	19.31	13.59
Plots in which equal numbers of plants were left when thinned	Mangels	5	35.17	32.23	24.47
	Sugar Beets	5	22.54	22.37	15.05
	Swede Turnips ..	5	18.77	17.85	10.40
	Fall Turnips	4	26.14	25.35	24.00
	Field Carrots	5	26.62	25.13	18.87

Note.—In the case of mangels and sugar beets the seed clusters instead of the separate seeds were used.

In the table here presented we have the average of no less than ninety-eight distinct experiments conducted with large, medium, and small seeds of five distinct kinds of field roots. It will be noticed that in every instance the large seed produced greater yields than the medium sized seed, and that the medium sized seed produced greater yields than the small seed.

New and Better Varieties Originated at the College.

The results mentioned under the heading "Selection of Seed Grain" are of great value in showing that in ordinary farm practice it is advisable to clean seed grain very thoroughly so that none but the best is sown. For plant improvement work, however, from a scientific standpoint, it is necessary to go beyond the mere selection of seed and to make selections from individual plants, and when necessary to make use of cross-fertilization in order to produce new varieties which are likely to be superior to the older ones. The variety tests at the College have formed an excellent basis for this work. During the past few years much stress has been placed upon the improvement of those varieties which have given the highest tests in the carefully conducted variety experiments. For the work in selection thousands of plants of the same variety have been grown at equal distances apart so as to give an opportunity for a careful study of the individual plants. As a result of this work we are now growing a number of selected strains of much prominence. These will be referred to in detail in the future pages of this bulletin.

The O. A. C. No. 21 barley, which was started in 1903 from a single plant selected from about ten thousand plants, is now thoroughly established in Ontario. The O. A. C. No. 72 variety of oats is increasing very rapidly throughout the Province. The O. A. C. No. 3, one of the thinnest hulled varieties which has ever been grown at the College, is taking its place amongst the early oats of the Province. The O. A. C. No. 61 variety of spring rye has shown itself to be the largest yielder of all the spring ryes tested at the College. The O. A. C. No. 81 soy beans is one of the best grain producers of the different kinds of soy beans which will mature at Guelph. These and other examples which might be mentioned show that the work in plant selection which has been conducted at the College is now bearing fruit throughout the Province. The influence of this work is increasing in value from year to year.

A large amount of work in cross-fertilization has also been carried out at the College within the past few years. object has been to secure new varieties which would be more suitable for Ontario than even the best of the named varieties which have been obtained through extensive experimental work and through selection of individual plants. We have a large number of cross-bred varieties of nearly all classes of grain crops and some of these are particularly promising, especially in certain characteristics.

It might be interesting in this connection to give the history of the O. A. C. No. 104 variety of winter wheat which has been originated at the O. A. C., and which was distributed to the farmers for co-operative experiments for the first time in the autumn of 1916, after being tested in the experimental plots at the College for a period of five years, the detailed results of which will be given in a later part of this bulletin.

In the summer of 1881 Robert Dawson, a farmer living near Paris, Ontario, had a promising field of the White Clawson variety of winter wheat. A very heavy

Laboratory in which a Study is being made of Selected and Hybrid Plants.

storm caused the grain c this field to become badly lodged. Mr. Dawson, while walking over the field of grain which had been flattened and partly beaten into the ground found one plant, the stems of which were mostly standing. He thought that possibly as this plant was more erect than the others it might be due to an unusually stiff straw. As the grain was ripened at the time he carefully saved the heads from this single plant. These were shelled by hand and the grains were sown in a little piece of ground near the house in the following autumn. As the growth was promising Mr. Dawson was soon enabled to increase the crop sufficiently to not only supply his own requirements but also to sell seed to his neighbors. A bag of the new wheat, under the name of Dawson's Golden Chaff, was entered at the Autumn Seed Fair at Guelph, and received first prize. It was tested in the experimental plots at the Ontario Agricultural College, and proved to be one of the stiffest strawed and most productive varieties under test. It was later distributed

to farmers over Ontario through the medium of the Ontario Agricultural and Experimental Union. It was increased in various localities and has for a number of years past been the most popular and the most extensively grown winter wheat in Ontario. It has a stiff straw, a red beardless head, and white grain. Although the Dawson's Golden Chaff is a heavy yielder the grain is comparatively soft and is more suitable for the manufacture of pastry and of breakfast foods than of flour for manufacturing into bread.

Another important variety of winter wheat, known as the Bulgarian, has been under test at the College for many years. It is also a white wheat, but with a medium strength of straw and a medium yield of grain per acre. This variety, however, has made a high record for bread production, as shown by tests in the Bakery Department at the College. It was thought that if the Dawson's Golden Chaff and the Bulgarian varieties could be cross-fertilized and a new variety originated, eliminating the undesirable and retaining the most desirable characteristics of the two parents, a very valuable acquisition might be made to agriculture.

A complete flower consists of two essential parts, the stamen and the pistil, and two floral envelopes, the corolla and the calyx. The two former contain the organs of reproduction and the two latter give the brilliancy and the beauty to the flower. Either the corolla or calyx, or both, may be absent, in which case the flower is said to be incomplete. It is usual for the stamens and the pistil to be in the same flower. Sometimes they occupy separate flowers on the same plants, and occasionally the stamens are produced on one plant and the pistils on another. In the case of wheat both the stamens and the pistil are found in the same flower. In each flower there are three stamens and one pistil. The stamens contain the pollen grains, which are small, uniform, and yellow in color, and the pistil the egg cells. For reproduction to take place it is essential that each egg cell be fertilized from a pollen grain.

Some of the farm crops such as wheat, barley, oats, peas and beans are naturally self-fertilized owing to the fact that fertilization takes place before the flowers are opened and exposed. In other instances, however, such as corn and rye, natural cross-fertilization takes place. This is clearly demonstrated in the case of corn. Every silk emanating from an ear must receive a vital pollen grain before a kernel of corn can be produced. As the pollen grains are produced on the upper part of the plant and the ears of corn some distance below, the pollen is usually conveyed to the corn silks through the agency of the wind. This accounts for the frequent mixing of varieties when grown in near proximity to each other.

From what has been said, it is evident that in order to secure hybrid grains of wheat it is necessary to artificially cross-fertilize the flowers. The O. A. C. 104 variety of winter wheat originated from a single cross between flowers of a choice plant of each of the Dawson's Golden Chaff and the Bulgarian varieties. Soon after a head of Bulgarian wheat appeared above the sheath a flower was carefully opened and the three immature stamens were removed. These were replaced by ripened anthers and pollen grains taken from a choice head of the Dawson's Golden Chaff. In due time fertilization took place and a hybrid grain was produced. This grain in the course of a few years produced a great variety of plants possessing different combinations of the characteristics of the two parents. These were carefully studied, and the one which received number 104 was found to possess in itself a combination of a number of the most desirable features of the two parent varieties.

The O. A. C. No. 104 variety is a vigorous grower with a comparatively stiff straw. The grain is white and the variety resembles the Dawson's Golden Chaff in

being beardless, and the Bulgarian in having a white chaff. It is to be hoped that this offspring may prove of even greater service than either of its parents.

For the results of this new hybrid wheat the reader is referred to the section of this bulletin under the heading "New Winter Wheats Originated at the O. A. C."

The Stinking Smut of Wheat and the Loose Smut of Oats.

Investigations have been conducted in the scientific departments of a number of institutions in a study of the best methods for treating the various smuts which occur in grain crops. As the result of these investigations certain recommendations have been made by different institutions. The Experimental Department at Guelph has made very careful tests in studying the practical application of some of the most highly recommended treatments for the destruction of the different kinds of smut. The results of these practical tests are of great value to the men actually engaged in the growing of grain crops in the Province of Ontario. We, therefore, present this information with the hope that it may exert a marked influence in largely preventing the ravages of these very troublesome fungus pests.

The spores of the smuts correspond with the seeds of the grains and germinate and grow when the conditions of heat, moisture and food become favorable. The smuts are fungus plants which enter the tissues of other plants, such as those of wheat, oats barley and corn, where they live and grow, and finally produce smut spores. The reproductive organisms of the loose smut of wheat and the loose smut of barley may exist in the tissues of the ripened grains, and it is, therefore, difficult to kill these two smuts, and also to retain the vitality of the wheat and barley. Although the hot water treatment may be effectual in killing these smuts, it is rather difficult to carry out satisfactorily in ordinary farm practice. It is important to secure seed wheat and seed barley from farms which are not infested with the loose smut of these grains. There is no effectual method known for preventing the smut of corn by a simple treatment of the seed, as the disease may attack any part of the tender growing plants at any time. The smut masses of corn should be gathered and burned and the spores thus prevented from being scattered on the land or embodied in the manure.

The spores of the loose smut of oats and of the stinking smut of wheat which attach themselves on the outer surfaces of the ripened grains can be readily killed by treatment. This fact is of great agricultural and economic importance. The information here presented should prove of much value in showing by actual experimental evidence that the loose smut of oats and the stinking smut of wheat can be completely and satisfactorily destroyed, and the crops entirely free from these diseases can be procured. If farmers grow wheat and oats which are infested with these smuts, they have themselves to blame. With a little care they can keep their farms practically free from these two pests which have frequently caused heavy losses in past years.

For five years in succession experiments have been conducted at the Ontario Agricultural College for the prevention of the loose smut of oats and of the stinking smut of wheat. Careful determinations were made each year to ascertain the comparative influence of different treatments. There were in all seven treatments for oats and five for wheat. In every instance, one sample was left untreated as a basis of comparison. An experiment was conducted in duplicate with oats, and also with wheat each year, there being two varieties of each class of grain used for the experiment. The seed grain was obtained each year from a known source, and where

no treatment for smut had been attempted for several years previously. The following treatments were used throughout, with the exception of numbers 3 and 6, which were omitted from the treatments for the stinking smut of wheat:—

(1) *Untreated.*—One sample of oats and one sample of winter wheat of each variety were left untreated, in order that the influence of the various treatments might be better observed.

(2) *Immersion in Hot Water.*—The grain was placed in a bag and immersed in water at about 115 degrees F. Soon afterwards it was placed in water which was kept at a temperature of between 130 degrees and 135 degrees F. The grain was occasionally stirred and was allowed to remain in the water for a period of fifteen minutes. It was then spread out on a clean floor to dry, where it was stirred occasionally.

(3) *Immersion in Bluestone Solution for Five Mirutes.*—A strong solution was made by dissolving one pound of copper sulphate (bluestone) in one gallon of water, and the oats were immersed in the solution for a period of five minutes.

(4) *Immersion in Blue Solution for Twelve Hours.*—The bluestone solution was made by dissolving one pound of bluestone in twenty-five gallons of water, and the grain was immersed in this solution for a period of twelve hours.

(5) *Sprinkling with Bluestone Solution.*—The solution was made by dissolving one pound of bluestone in ten gallons of water, which was used for sprinkling over the grain until it was thoroughly moistened after being carefully stirred.

(6) *Immersion in Potassium Sulphide Solution.*—The potassium sulphide treatment consisted of soaking the oats for two hours in a solution made by dissolving eight pounds of potassium sulphide in fifty gallons of water.

(7) *Immersion in Diluted Formalin.*—The solution of formalin (40 per cent. formaldehyde) used for the immersion process with oats and with wheat was made by pouring one-half pint of the formalin into twenty-one gallons of water, and the grain was immersed in this solution for a period of twenty minutes, during which time it was stirred occasionally.

(8) *Sprinkling with Diluted Formalin.*—One-half pint of formalin was poured into five gallons of water and the grain was sprinkled with this solution and stirred until it was thoroughly moistened.

After the treatments had been made for a few hours, and the grain had become sufficiently dried, it was carefully sown on separate plots. When the winter wheat was about ready to cut, it was carefully examined and the heads containing stinking smut were gathered and shelled. The rest of the crop was then threshed and again examined for any smut balls from heads which had been missed in the standing crop. When the oats were coming into head they were examined frequently and all smutted heads were removed and carefully counted. The accompanying table gives the average results in the percentage of grains of winter wheat affected with stinking smut and of the heads of oats affected with loose smut in each of the **Five Years** during which each experiment was conducted. Besides this information, the average yield of winter wheat per acre for the three years and the average yield of oats per acre for five years are included:—

RESULTS OF EXPERIMENTS TO KILL THE STINKING SMUT OF WHEAT.

Materials.	Percentage of Smut. (Average 5 Years).						Average yield of Grain per Acre 3 Years (bush.)
	First Year Test.	Second Year Test.	Third Year Test.	Fourth Year Test.	Fifth Year Test.	Average 5 Years.	
1. Untreated	3.6	9.3	.6	.6	6.8	4.2	36.0
2. Hot Water	.0	.0	.0	.0	.0	.0	40.6
4. Bluestone—12 hours	.0	.0	.0	.0	.0	.0	40.2
5. Bluestone—Sprinkled	.0	.2	.0	.0	.1	.1	41.1
7. Formalin—Immersed	.0	.0	.0	.0	.0	.0	43.3
8. Formalin—Sprinkled	.0	.0	.0	.0	.0	.0	36.3

RESULTS OF EXPERIMENTS TO KILL THE LOOSE SMUT OF OATS.

Materials.	Percentage of Smut. (Average 5 Years).						Average yield of Grain per Acre 5 Years (bush.)
	First Year Test.	Second Year Test.	Third Year Test.	Fourth Year Test.	Fifth Year Test.	Average 5 Years.	
1. Untreated	5.5	3.9	11.6	4.3	3.4	5.7	60.3
2. Hot Water	.0	.0	.0	.1	.0	.0	63.7
3. Bluestone—5 minutes	1.7	.9	.7	.6	.1	.6	58.5
4. Bluestone—12 hours	.6	.0	.0	.1	.0	.1	56.0
5. Bluestone—Sprinkled	.9	2.0	1.4	.6	1.6	1.3	61.6
6. Potassium Sulphide	3.4	.1	.3	1.5	.7	1.2	66.2
7. Formalin—Immersed	.0	.0	.0	.0	.0	.0	63.3
8. Formalin—Sprinkled	.0	.1	.0	.0	.0	.0	61.3

The results here show that treatment No. 7 was not only effectual in killing the smut entirely, but it also was the means of giving the highest average yield of grain per acre of the various treatments used in the case of wheat and also oats. The immersion process is so complete in its results that it does not need to be repeated every year, providing care is exercised to prevent a further introduction of the smut spores. In preparing wheat for treatment, care should be taken to separate the unbroken smut balls from the wheat, either by cleaning the grain or by placing the seed in water and removing the smut balls as they float on the surface. Not only is it necessary to treat the grain, but the formalin solution should be used to kill the smut spores which are lodged in the bins, on the barn floors, on the bags, in the grain drills, or wherever the living spores have an opportunity of again coming in contact with the grain.

The sprinkling process is used by some farmers, but unless great care is taken this method is not complete in destroying all of the smut, and as a result it is frequently necessary to treat the grain every year. One of the best methods is to carefully moisten twenty-five bushels of wheat by shovelling it over on a barn floor when it is being sprinkled with a mixture of one-half pint of formalin and from fifteen to twenty-one gallons of water. When the grain is uniformly moistened it should be covered with bags or blankets for three or four hours, and then spread out to dry. Varying quantities should be treated proportionately.

Further experimental work in treating grain for smut is now being conducted. [I]ncludes not only the hand methods, but also the use of some machines which [m]anufactured for this purpose. Different strengths o. solution for the

sprinkling process have been used in each of the past two years. Ten different treatments were tested in duplicate in 1917 and thirteen in 1918, the latter including what is known as the dry method.

Smut Resistance in Oats.

We have very clear evidence that there is a great variation in different varieties of oats in regard to smut resistance. An examination of different varieties has shown that some kinds possess a very much larger amount of smut than other varieties when grown under similar conditions. This has been tested out in various ways. The number of smut heads per plot of all our varieties of oats have been determined annually for the last seventeen years. The following table gives interesting information regarding the number of smut heads per plot in each of five different varieties:—

Number of Smutted Heads per Plot

	Year.	Early Ripe.	Joanette.	Siberian.	American Banner.	Black Tartarian.
Before Treatment.	1902	0	20	32	116	332
	1903	0	9	43	303	608
	1904	3	10	78	317	369
	1905	0	18	20	22	62
	Seed Treated in Spring of 1906.					
After Treatment.	1906	0	0	0	0	0
	1907-12 Average 6 years.	0	2	1	3	17
	1913-18 Average 6 years.	1	2	4	6	58

The foregoing results are very interesting. In the seventeen years the Early Ripe variety of oats had only six smutted heads, while the Black Tartarian had 1817. In the seventeen-year period the grain was treated for smut only in the spring of 1906. Although some of the varieties had been very badly smutted previous to that year it will be seen that in 1906 there was not a trace of smut in any one of the varieties. In the following twelve years, however, the oats had again become slightly smutted, the amount for the last six years being greater than that of the former six-year period. Two of the important points in connection with this test is the fact that the different varieties of oats vary so much in their susceptibility to smut and that if the treatment is carried on with care every particle of smut can be climinated even from those varieties which are very susceptible to the attacks of smut in large quantities. The grain was treated as described under No. 7 method previously explained. This method has always proven very effectual in treating both oats for the loose smut and wheat for the stinking smut in the work in the Field Husbandry Department at the College.

Grains Grown in Combination.

According to the reports of the Ontario Bureau of Industries the areas used for mixed grains was 619,389 acres in 1918, 515,593 acres in 1917, and 485,986 acres in 1916. In no year did the acreage reach one-half million until 1917. It will, therefore, be seen that the farmers of Ontario are growing grains in combination in increasing quantities.

In the past twenty-four years a large number of experiments have been conducted at the College in growing different classes and different varieties of grain in combination for the production of green fodder, of hay and of grain. Many valuable results have been obtained. A number of these have already been presented in the annual reports of past years and other experiments are now under way.

The results of experiments show that for green fodder and for hay, a mixture of two bushels of oats, such as, the Siberian, the O. A. C. No. 72, or the Banner varieties and one bushel of peas, such as, the Multipliers, the Golden Vine, or the Prussian Blue varieties, makes an admirable seeding for growing in combination.

For grain production, one bushel of the O. A. C. No. 3, the Danbeney, or the Alaska oats combined with one bushel of the O. A. C. No. 21 barley have given excellent satisfaction as a farm crop. The O. A. C. No. 3 oats have largely taken the place of the Danbeney variety for this purpose. The results of our experiments have shown that a combination of the best variety of oats and the best variety of barley, grown together in the right proportion, will produce on an average fully two hundred pounds of grain per acre more than either one grown separately. The experiments, which have been conducted in the past at the College, seem to indicate that there is but little advantage from growing in combination two different varieties of the same class of grain, but there are often marked advantages from growing suitable varieties of different classes of grain together. Of all the combinations used, none have given as large a yield of grain per acre as the most suitable combination of oats and barley.

Sowing Spring Grains at Different Dates.

For five years in succession an experiment was conducted at the Ontario Agricultural College in sowing spring wheat, barley, oats and peas at six different dates in the spring, commencing as early as the land could be worked satisfactorily and allowing one week between each two dates of sowing. The varieties of grain used in this experiment were Herison Bearded and Pringle's Champion spring wheat. Mandscheuri and Kinna Kulla barley, Siberian, Oderbrucker, and Waterloo oats, and Early Britain and White Wonder peas. In each year the experiment was conducted in duplicate by sowing one plot at each date of seeding with the grain drill and another plot broadcast by hand. The result from the two methods were averaged each year. It will, therefore, be seen that there were ten separate tests in this experiment. The average results of the ten distinct tests conducted in the **Five-Year** period are as follows:—

Dates of Seeding.	Yield of Straw per Acre (tons.)				Weight of Grain per Measured Bushel (pounds).				Yield of Grain per Acre by Weight (bushels).			
	Spring Wheat.	Barley.	Oats.	Peas.	Spring Wheat.	Barley.	Oats.	Peas.	Spring Wheat.	Barley.	Oats.	Peas.
First.....	1.2	1.2	2.0	.9	60.1	52.3	33.9	56.6	21.9	46.2	75.2	25.4
Second	1.1	1.2	2.1	1.1	59.6	52.6	34.5	56.6	19.2	45.9	76.0	28.8
Third	1.0	1.1	1.8	1.1	59.0	51.8	32.1	57.6	15.4	39.8	64.2	28.5
Fourth	.9	1.0	1.7	1.0	58.9	50.3	29.9	57.4	13.0	37.1	55.8	25.5
Fifth	.6	.9	1.6	.9	56.5	48·2	27.3	57.0	8.4	27.6	45.2	21.5
Sixth.....	.8	.9	1.7	1.0	54.0	45.1	24.2	57.0	6.7	18.4	35.0	19.5

The dates of starting and closing the test varied in different years according to seasonal conditions. The average dates of sowing were as follows:—1st, April 18th; 2nd, April 24th; 3rd, May 2nd; 4th, May 10th; 5th, May 17th; 6th, May 25th.

It will be seen that the best results were obtained from sowing both spring wheat and barley as soon as the land was in proper condition for cultivation in the spring. With oats it mattered but little whether seeding took place at the beginning or the end of the first week on which the land could be worked satisfactorily. The results from the tests with peas, however, show that the best returns were obtained from the second date of seeding, and that even the fourth date gave as large a yield of both grain and straw per acre and as high a weight of grain per measured bushel as was obtained from the first seeding. These results show the importance of sowing very early in the spring and in the following order: Spring wheat, barley, oats and peas.

It is interesting to note that there was a gradual decrease in crop production as the dates advanced from the beginning to the end of the test. According to the results of the experiment, there was an average decrease in yield per acre of 27 pounds of spring wheat, 47 pounds each of barley and of oats, and of 20 pounds of peas for each day's delay. It is, therefore, essential, if the best results are to be obtained, to sow these spring grains very early in the spring.

Dates of Sowing Emmer and Spelt.

Emmer and spelt are used in some countries to a limited extent for flour production. When used for this purpose, however, special machinery is required for separating the chaff or the hull from the grain, as the grain is usually surrounded by the chaff after being threshed. In this country these grains are considered from the standpoint of the amount of feed which they will produce for farm stock. Emmer is about equal to barley for feeding purposes.

In each of five years both emmer and spelt were sown on eight different dates in the spring, by making the first date in the season as early as the land was suitable for cultivation. One week was allowed between each two dates of seeding. The Common Emmer and the Red Spelt were the special varieties used. The average results of the experiment for **Five Years** are presented in the following table:—

Dates of Seeding.	Yield of Straw per Acre (tons).		Weight of Grain per Measured Bushel (pounds).		Yield of Grain per Acre (pounds).	
	Spelt.	Emmer.	Spelt.	Emmer.	Spelt.	Emmer.
First	1.6	1.9	28.3	40.1	2,377	2,747
Second	1.6	2.0	27.3	39.1	2,163	2,848
Third	1.7	2.0	26.3	39.1	1,898	2,646
Fourth	1.6	2.1	24.9	37.6	1,582	2,754
Fifth	1.5	2.1	24.2	36.7	1,287	2,569
Sixth	1.6	2.3	21.6	36.1	933	2,465
Seventh	1.5	2.4	19.6	35.4	685	2,312
Eighth	1.5	1.9	19.9	34.0	499	1,953

The figures representing the pounds per measured bushel and the pounds of grain per acre include the chaff or hull surrounding the grain, as well as the grain itself. In the examination of the results here presented, the reader will be impressed with the superiority of the emmer as compared with the spelt in weight of grain per measured bushel, and in yield of both straw and grain per acre. In no instance does the spelt show a better record than the emmer. It will be noticed that even the fourth seeding of emmer produced a higher yield of grain per acre than that obtained from the first seeding. The results, from this and the preceding experiment, seem to indicate that emmer may be sown at a later date than other classes of spring grain.

Varieties of Oats.

Of all the small grains grown in Ontario oats are decidely the most important. The market value of the oat crop of Ontario in 1917 was about $86,000,000, and in 1918 about $100,000,000, and the average for the past twelve years has been approximately $40,000,000 per annum. In 1918 there were 2,924,468 acres used for the production of oats. This was the largest area ever used for oats in this Province. The production of oats in 1918 was 131,752,601 bushels, while the average of the previous thirty-six years was 82,479,705.

Over three hundred varieties of oats have been carefully tested in the experimental grounds at the College, but many of these have been dropped after they have been grown for five years in succession owing to the fact that other varieties have proven more successful. Each year a few new varieties are added and a few of the inferior ones are dropped. Nine varieties of oats have been grown under test continuously at the College for the last twenty-nine years. The following gives the average percentage of hull for twelve years and the average yield of grain per acre for **Twenty-Nine Years** of each of the nine varieties here referred to:—

Varieties.	Percentage of Hull. Average 12 Years.	Yield of Grain per Acre. Average 29 Years (bushels).
Siberian	29.4	89.9
Probsteier	28.3	86.9
Oderbrucker	30.1	86.3
Waterloo	27.4	85.4
Bavarian	28.2	84.5
Joanette	23.8	83.4
American Banner	30.1	82.8
Egyptian	31.5	77.0
Black Tartarian	31.2	70.7

Of the nine varieties of oats here reported all are white in color of grain except the Black Tartarian, and all have spreading heads except the Egyptian and the Black Tartarian, each of which has a side head.

It will be seen that there is a variation in average percentage of hull from 23.8 for the Joanette to 31.5 for the Egyptian. One hundred pounds of the

Joanette to 31.5 for the Egyptian. One hundred pounds of the Joanette would therefore furnish 7.7 pounds more meal than a similar amount of the Egyptian variety. In yield of grain per acre over the twenty-nine year period there is a difference of 19.2 bushels per acre per annum in favor of the Siberian over the Black Tartarian. The Black Tartarian variety of oats was grown considerably and was fairly popular in Ontario about thirty years ago.

The full results of the experiment with all the varieties of oats grown under experiment in 1918 are not completed at the time of writing this bulletin. In the five years finishing with 1917, thirty-eight named varieties in addition to the various selections and hybrids have been under test. Of these thirty-eight varieties grown for five years, the highest average yields were produced by Yellow Sixty-Day, Prosperity, Alaska, Iowa Silver Mine and Sixty-Day White. In the five-year period those varieties which gave the smallest average amount of hull per acre were Joanette, Early Ripe, and Daubeney; and those which had the greatest percentage of hull were Pioneer, Early Dawson, White Superior Scotch, Garton's Record, Storm King, and Egyptian.

Some of the new varieties of oats originated at the College by selection from individual plants, and particularly from cross-fertilization, have given a less percentage of hull than any of the three hundred named varieties of oats secured from different parts of the world. The two varieties of oats originated at the College from selection in our trial grounds have been introduced and are now grown extensively throughout Ontario under the names O. A. C. No. 72 and O. A. C. No. 3. The record of these two varieties will be reported more fully under a separate heading and in comparison with two old standard varieties.

Two New Valuable Varieties of Oats.

Two varieties of oats have been originated at the College by selection through the medium of nursery plots. These varieties of oats have been tested at the College and throughout the Province, and are now grown extensively on thousands of farms in Ontario.

In the spring of 1903 about ten thousand grains of the Siberian oats were planted separately at equal distances apart in a large nursery plot. This gave the separate plants an opportunity for development under fairly uniform conditions. When the grain was ripe the plants were all carefully examined, and those presenting the most desirable characteristics were harvested separately and carefully stored. The selected plants were afterwards given a more critical examination in the plant breeding laboratory, and those possessing the largest amount of the best seed were retained for future work. In the spring of 1904 a certain number of the seeds from each of the plants were planted by hand in separate rows which furnished an opportunity for a study of the characteristics of the progeny of the individual plants. A critical study was made of these different strains, and only the best were continued in the test. From seed obtained in the rows plots were sown and the crops were compared with other selections, hybrids and varieties. As the result of this careful investigation it was found that what is now called the O. A. C. No. 72 seemed to possess the greatest combination of the most desirable

characteristics. This variety has now been tested in the large plots in each of the past twelve years, the results of which are here presented, in comparison with those of the American Banner oats which were grown under similar conditions. The American Banner has been the variety which has been most extensively grown in Ontario during the past number of years.

The O. A. C. No. 3 variety of oats originated from a single plant selected from the regular variety plot of the Daubeney oats in 1904. The writer at that time selected a number of plants which apparently combined the most desirable characteristics. These plants were threshed separately, and the grain was carefully retained for future work. After careful tests were made with the individual strains, it was found that the oat which now receives the name of O. A. C No. 3 contained the greatest number of valuable points. The results of this particular strain are presented in comparison with those obtained from the Daubeney oats, from which the plant was originally selected. These are both exceptionally early varieties and are suitable not only for growing as separate varieties, but also for combining with barley when it is desired to grow the two in combination for grain production.

The following table gives the percentage of hull and the yield per acre of the O. A. C. No. 3 in comparison with the Daubeney, and the O. A. C. No. 72 in comparison with the Banner in each of the past **Twelve Years**:—

Sheaf of O. A. C. No. 3 Oats. (Reduced to one-eighth.)

Years.	Percentage of Hull.				Yield of Grain per Acre (bushels).			
	Early.		Late.		Early.		Late.	
	Daubeney.	O. A. C. No. 3.	Banner.	O. A. C. No. 72.	Daubeney.	O. A. C. No. 3.	Banner.	O. A. C. No. 72.
1907	24.7	24.7	28.3	27.2	80.79	86.29	65.94	76.38
1908	23.8	23.6	28.6	25.4	88.97	89.24	83.50	86.82
1909	25.4	24.8	29.6	28.7	98.35	104.88	70.41	102.94
1910	24.9	24.4	29.6	28.6	87.00	90.35	73.62	93.59
1911	26.2	25.0	31.3	27.8	42.12	49.76	30.41	43.97
1912	24.6	23.8	35.5	28.0	76.47	91.65	73.44	114.12
1913	24.5	23.0	29.2	25.6	60.41	94.12	74.38	105.74
1914	25.9	24.3	30.7	28.9	63.88	57.53	88.00	88.50
1915	23.9	21.7	29.1	28.4	73.21	76.00	92.76	103.53
1916	26.1	27.2	32.0	32.9	53.91	74.91	67.56	65.91
1917	23.8	22.7	27.2	26.1	100.24	111.68	101.74	86.59
1918	25.2	23.0	28.5	27.8	92.29	105.32	85.27	89.18
Average 12 Years	**24.9**	**24.0**	**30.0**	**28.0**	**76.47**	**85.98**	**75.59**	**88.11**

As the Daubeney amongst the early, and the Banner amongst the late varieties of oats have been the standard varieties of Ontario for many years, it was interesting to compare the new varieties with these standard sorts.

The tabulated results here presented for each year show that in percentage of hull in only one instance was the O. A. C. No. 3 greater than that of the Daubeney, and in only one year was that of the O. A. C. No. 72 greater than that of the Banner. The average percentage of hull for the twelve-year period shows the O. A. C. No. 3 to be about one per cent. less than the Daubeney, and the O. A. C. No. 72 two per cent. less than the Banner. The detailed results show that, in yield of grain per acre, the O. A. C. No. 3 surpassed the Daubeney in eleven out of the twelve, and the O. A. C. No. 72 surpassed the Banner in ten out of the twelve years. The average results show that the O. A. C. No. 3 surpassed the Daubeney by an annual yield of 9.5 bushels per acre per annum, and the O. A. C. No. 72 surpassed the Banner by 12.5 bushels per acre per annum.

Sheaf of O. A. C. No. 72 Oats.
(Reduced to one-tenth.)

In average annual yield in tons of straw per acre, the four varieties of oats gave the following returns: Daubeney, 1.86; O. A. C. No. 3, 1.89; Banner, 2.03; and O. A. C. No. 72, 2.15.

The average number of days from the time the seed was sown until the crop was ready to harvest for the twelve-year period is as follows: Daubeney, 104; O. A. C. No. 3, 102; Banner, 111; and O. A. C. No. 72, 111.

It will, therefore, be seen that the O. A. C. No. 3 is a very early, thin hulled, high yielding oat with a fair amount of straw, and that the O. A. C. No. 72 ripens at practically the same time as the Banner and has surpassed the latter variety in yield of grain, quality of grain and in yield of straw.

In the co-operative experiments throughout Ontario, the O. A. C. No. 72 variety has headed the list in yield per acre in each of the past six years.

The O. A. C. No. 72 variety of oats appears to be displacing many of the old varieties of oats, even the Banner, which has for many years been the most extensively grown variety in the Province. In 1913 only one farmer had a sufficiently large field of the O. A. C. No. 72 to enter it in the Field Crop Competition in his locality and this field received the first prize. Since that date, this variety has increased rapidly in connection with the Standing Field Crop Competitions in Ontario. The O. A. C. No. 72 and the Banner varieties have each taken first prize in the Ontario Field Crop competition as follows:—

Year.	Banner.	O.A.C. No. 72
1913	41	1
1914	34	20
1915	33	48
1916	26	76
1917	25	85

At the Provincial Winter Fair, entries have been made of the O. A. C. No. 72 oats in recent years as follows: 1913, 3; 1914, 36; 1915, 57; 1916, 71. In 1916 and 1917 there were more entries for this oat than for all other oats combined, and fully three times as many as those for the Banner. The average yield of oats per acre on nearly three million acres throughout Ontario in 1918 was 42.6 bushels. This average yield per acre has not been surpassed during the thirty-seven years in which the statistical information has been gleaned throughout Ontario through the medium of the Bureau of Industries for the Province. This popular oat is having a marked influence in increasing production, and it is even now worth millions of dollars to Ontario annually.

A Test of the Stooling of Oats.

The stooling of grains is influenced by the fertility of the soil, the conditions of the weather, the thickness of seeding, the variety of grain, etc. The fertility of the soil, the thickness of the sowing and the varieties used are largely under the control of the farmer. In the results of our experiments in each of the past ten years, the varieties of oats have shown very marked differences in their stooling properties. We here present the **Ten Years'** results of each of a number of varieties of oats which were grown under uniform conditions:—

Varieties.	Average Number of Stools per Plant.										
	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	Average 10 Years.
Joanette	21	18	15	26	16	16	19	9	15	13	**16.8**
Burt	22	13	17	19	18	17	20	9	15	11	**16.1**
Early Ripe	19	13	16	19	16	19	21	10	16	12	**16.1**
Yellow Kherson	19	13	15	18	15	13	18	9	14	12	**14.6**
Daubeney	18	11	14	14	12	9	15	9	12	10	**12.4**
Sixty-Day	17	12	13	14	10	10	13	8	9	10	**11·6**
American Banner	17	10	13	14	10	11	13	9	9	9	**11·5**
Siberian	14	12	11	12	9	11	13	9	10	8	**10.9**
Reg. Abundance	11	10	11	14	10	11	13	8	9	8	**10.5**
Storm King	8	6	6	9	6	6	8	5	5	5	**6.4**
Tartar King	8	5	6	8	6	6	6	5	4	4	**5.8**

Great care was exercised in the sowing of the oats in this experiment, the seed being planted in squares one foot apart in each direction. In this way the plants had an opportunity for the development of stools and to bring out the characteristics of the individual varieties. It will be seen that there is a variation

in the average number of stools from 5.8 in the case of the Tartar King to 16.8 in the case of Joanette. It will also be seen that the three lightest stooling varieties are the Tartar King, the Storm King, and the Regenerated Abundance, three varieties of oats brought to Canada by the Garton Bros., of Warrington, England. Both the Storm King and the Tartar King are light yielders of grain. The American Banner of the late oats and the Daubency and the Sixty-Day of the early oats have almost equal stooling properties. The heavy stooling varieties in comparison with the light stoolers, when sown broadcast under average conditions, have given a somewhat higher yield of grain per acre.

Percentage of Hull in Oats.

The quality of the oat crop is determined to a greater extent by the percentage of hull than many people realize. Until recently, but little attention was given to the percentage of hull in oats, either in this country or in Europe. As a result, we find that in the past a number of thick hulled and consequently inferior varieties of oats were introduced and grown in Canada. The percentage of hull in oats is considered of so much importance that it is thought advisable to draw particular attention to the differences in this respect as shown by varieties over a series of years. Four varieties have, therefore, been selected to show the importance of paying more attention to this important characteristic. The chemical composition of oats varies considerably, and these variations are largely due to the percentage of hull found in the different varieties:

Year.	Percentage of Hull.			
	Joanette.	Daubeney.	Early Dawson.	Pioneer.
1902	22.5	26.1	32.6	48.1
1903	23.1	25.1	33.7	36.8
1904	22.5	23.0	32.4	36.9
1905	24.0	26.3	36.0	36.8
1906	25.2	26.3	38.1	42.8
1907	23.4	24.7	33.7	38.8
1908	23.9	23.8	36.6	37.4
1909	25.4	25.4	36.8	36.7
1910	23.9	24.9	31.4	33.5
1911	23.9	26.2	34.1	36.8
1912	24.3	24.6	25.8	37.0
1913	22.4	24.5	33.1	35.3
1914	24.3	25.9	34.4	36.7
1915	23.1	23.7	31.7	35.1
1916	24.2	26.1	39.9	40.2
1917	21.6	23.8	35.2	34.7
1918	25.5	25.2	34.5	55.6
Average 17 Years	**23.7**	**25.0**	**34.7**	**37.6**

The four varieties of oats included in the preceding table have all been grown in Ontario more or less extensively in recent years. The tabulated results show very clearly the great differences in the amount of hull of different varieties. They also show that these differences are fairly constant from year to year. With only three slight exceptions, the Joanette proved to be thinner in the hull than any of the other three varieties in any of the past seventeen years. The Daubeney was thinner in the hull than the Joanette by .1 per cent. in 1908, and by .3 per cent. in 1918, and the two varieties possessed exactly about the same amount of hull in 1909. Without a single exception the Early Dawson possessed a thicker hull than

the Daubeney, and, with only two slight exceptions, the Pioneer produced a thicker hull than the Early Dawson. In the average of the seventeen-year period, it will be seen that the Pioneer had an annual percentage of hull of 14.9 over the Joanette. This would mean that the Joanette would contain approximately fifteen pounds of meal more than the Pioneer for each average one hundred pounds of oats. As the average value of the oat crop of Ontario amounts to about fifty million dollars annually, it will be seen that a difference of one per cent. in the hull of oats

Sheaf of O. A. C. No. 21 Barley.
(Reduced to one-tenth.)

would make a difference approximately one-half million dollars in the value of the oat crop of Ontario in a single year. This point is worthy of careful consideration by the farmers of Ontario.

Varieties of Spring Barley.

With the exception of oats, barley is grown more extensively in Ontario than any of the other small grains. In 1918, 24,247,673 bushels of barley were grown in Ontario on 660,404 acres. This is a yield of 36.7 bushels per acre, which is the highest recorded in the last thirty-seven years, the next greatest yield per acre

being 36 bushels, which was the average for 1915. The barley crop is, therefore, exceedingly important in connection with the agriculture of this Province. As is shown in the earlier part of this report, it is the highest in the production of digestible food constituents of all the small grains grown in Ontario.

Spring barley as grown in the Experimental Department at Guelph can be divided into three distinct classes, viz.: the six-rowed, the two-rowed and the hulless. These three classes differ from each other in several respects. As a rule, the six-rowed barleys are earlier in maturing and give comparatively larger yields of grain per acre than the two-rowed. The hulless barleys have a standard weight per measured bushel of 60 instead of 48 pounds. The straw is usually short and somewhat inclined to lodge.

Average Results for Five Years.

Classes and Varieties.	Bearded or Bald.	Color of Grain.	Average Height (ins.).	Per Cent. of Rust.	Days to Reach Maturity.	Weight per Measured Bushel (lbs.).	Yield per Acre.	
							Straw (tons).	Grain (bush.).
Six-rowed—								
California Brewing	Bearded	White	30	5	104	48.00	1.75	**65.79**
O. A. C. No. 21	"	"	39	3	104	49.20	1.95	**63.39**
Mandscheuri	"	"	38	4	104	49.55	1.92	**63.15**
Zulu King	"	Black	29	5	103	49.35	1.58	**59.70**
Oderbrueker	"	White	38	3	104	50.40	1.83	**59.29**
Oregon	"	"	29	3	111	45.40	1.67	**53.48**
Mensury	"	"	34	4	103	53.15	1.73	**49.71**
Success	Bald	"	33	3	98	48.40	1.40	**48.52**
Common Six-rowed	Bearded	"	36	3	103	52.35	1.73	**47.20**
Two-rowed—								
Binder Barley	Bearded	White	31	4	108	54.65	1.81	**65.95**
Gold Barley	"	"	30	3	108	55.30	1.89	**63.13**
Svalof's Hannchen	"	"	31	3	108	53.80	1.78	**59.66**
Hanna No. 5590 (Iowa)	"	"	31	3	108	54.15	1.90	**59.13**
French Chevalier	"	"	32	3	109	53.10	1.94	**58.48**
Two-rowed King	"	"	30	3	108	52.05	1.77	**54.62**
Svalof's Princess	"	"	30	3	110	53.05	1.80	**52.16**
Two-rowed Canadian	"	"	33	5	109	52.30	1.50	**42.84**
Duckbill	"	"	33	6	110	51.05	1.62	**41.47**
Hulless—								
Black Hulless	Bearded	Black	28	2	102	62.85	1.64	**44.88**
Purple	"	Purple	27	3	102	63.05	1.63	**42.51**
Winnipeg No. 2	"	White	25	3	103	59.55	1.81	**41.80**
Guy Mayle	"	Green	25	4	100	60.35	1.44	**41.61**
New White Hulless	Bald	White	26	4	106	60.40	1.63	**33.18**

The California Brewing barley, which has given the highest yield of grain per acre is a comparatively poor variety in all respects except in productiveness. It is a coarse, stiff bearded, thick hulled barley which weighs comparatively light per measured bushel and which has short, weak straw. The grain is usually very dark in color and is often used for class-room work as an inferior type of barley. It is quite possible that it may grow a grain of better quality in California than it does in Ontario. Although there is not much difference in the results of the O. A. C. No. 21 and the Mandscheuri in the record of the past five years, the O. A. C. No. 21 has made the best all-round record both at the College and especially in the co-operative experiments throughout Ontario. The O. A. C. No. 21 is a stiff strawed, large yielding barley, and the grain is of excellent quality. The

two-rowed barleys have given unusually large yields during the last few years of abnormal seasons. Two-rowed barleys are grown quite extensively in England and in other parts of Europe, but have not as a rule given as good results as six-rowed barleys in Ontario. The reader will notice from the earlier part of this report that during the last four years there has been an exceptionally large amount of rainfall in Ontario. This produced conditions more nearly resembling those of Great Britain than occurs in normal years. Under normal conditions, six-rowed barleys surpass the two-rowed barleys in productiveness. It should be clearly understood that the standard weight per measured bushel of hulless barley is 60 instead of 48 pounds.

The O. A. C. No. 21 variety of barley has become exceedingly popular throughout the Province and is supplanting all other varieties, even the Mandscheuri, which the College introduced about thirty years ago and which has done so much in the improvement of barley growing in Ontario. It is now estimated that about 95 per cent. of all the barley which is grown in Ontario belongs to the Mandscheuri or the O. A. C. No. 21 varieties, the latter largely predominating.

Field of O. A. C. No. 21 Barley on the College Farm.

Of about forty entries of barley at the Provincial Winter Fair, held in each of the past three years, with only one exception in one year, all the entries were of the O. A. C. No. 21 variety. In the competition of Standing Field Crops throughout Ontario last year, there were 53 fields of barley entered. Of this number, 41 were of the O. A. C. No. 21 and 8 of the Mandscheuri variety, leaving only one entry of any other kind. In the Standing Field Crop Competitions throughout Ontario for the past three years, the O. A. C. No. 21 has taken first place without an exception in all the twenty-eight separate competitions with barley, there being at least ten fields entered in each competition.

Winter Barley.

Winter barley is not grown as a commercial crop in Ontario. Experiments have been conducted at the College, however, with several varieties of winter barley obtained from different sources, one object being to test the different kinds of winter barley in existence, and another to ascertain whether by continuous growing of winter barley at the College over a long series of years the hardiness of the grain could be improved. The following gives the average of **Six Years'** results of each of five varieties of winter barley:—

Varieties.	Weight of Grain per Measured bushel (pounds).	Yield per Acre.	
		Straw. (tons).	Grain (bushels).
Tennessee	49.7	1.4	56·2
Wood's	49.4	1.3	51.7
Groninger New	48.9	1.1	38.2
Groninger No. 1	47.9	1.1	38.1
Groninger No. 2	48.7	1.0	34.0

In height, the first two named varieties had an average of 34 inches each, and the last three from 30 to 31 inches.

We have now had one strain of winter barley under experiment at the College in each of the past twenty-five years. In three of these years the crop was an entire failure owing to winter killing. Those three years, however, occurred within the first six years of the experiment. There has been no complete failure with the crop since 1900. The average yield per acre for the twenty-two out of the twenty-five years in which the barleys survived winter was 48.2 bushels per acre per annum, and the average weight per measured bushel was 52 pounds. The yield in bushels per acre during the past nineteen years has had a range of from 42.3 the lowest to 52.5 the highest. The yield per acre in 1918 was 48.5 bushels as determined in the experimental grounds.

Varieties of Winter Wheat.

About three hundred varieties of winter wheat and many selections and crosses have been grown under experiment at the Agricultural College within the past twenty-nine years. Nearly all of the varieties have been carefully tested in each of five years, after which the inferior kinds have been discarded and those which have given the best results have been continued in the experiments. Of the named varieties fourteen have been grown in each of twenty-three years, and the results of these are of special value. The following table gives for each of these fourteen varieties the average weight per measured bushel for twenty-two years, and the average yield of both straw and grain per acre for the **Twenty-Three** year period:—

Varieties.	Color of Grain.	Pounds per Measured Bushel. Average 22 years.	Yield per Acre. Average 23 Years.	
			Straw (tons).	Grain (bushels).
Dawson's Golden Chaff.	White	59.5	2.8	48.7
Imperial Amber	Red	60.8	3.1	46.8
Egyptian Amber	Red	61.2	3.1	44.9
Early Genesee Giant	White	59.8	2.9	44.6
Early Red Clawson	Red	58.6	2.7	44.3
Rudy	Red	61.0	2.7	43.4
Tasmania Red	Red	61.4	2.8	43.3
Tuscan Island	Red	61.0	2.8	43.0
Turkey Red	Red	61.1	2.7	42.3
Geneva	Red	61.6	2.9	42.2
Kentucky Giant	Red	60.6	2.7	41.7
Bulgaria	White	60.4	2.7	40.9
McPherson	Red	61.5	2.5	40.7
Treadwell	White	59.5	2.7	40.1

The average results of the fourteen varieties for the whole period are as follows: Yield of grain per acre 43.4 bushels, yield of straw per acre 2.8 tons, and weight per measured bushel 60.6 pounds.

The Dawson's Golden Chaff is still the most extensively grown variety of winter wheat in Ontario, according to information secured through correspondence with practical farmers. This variety, in the results of Guelph for twenty-three years, has given an annual average yield of grain per acre of 1.9 bushels over the next highest variety, and of 8.6 bushels per acre over the lowest yielder of the fourteen varieties included in the test, all of which were grown under similar conditions. The Dawson's Golden Chaff was originated in Ontario thirty-seven years ago. It produces a very stiff straw of medium length, beardless heads with red chaff, and white grain which weighs about the standard per measured bushel. It is probable that the Dawson's Golden Chaff is improving slightly in quality for bread production.

The following table gives the average yield per acre for **Nine Years** of each of **Twenty-Eight** varieties: —

Varieties.	Bearded or Bald.	Color of Chaff.	Color of Grain.	Yield per Acre. Average 9 Years. Bushels Grain.
American Banner	Bald	Red	White	57.3
No. 6	"	"	"	56.2
Dawson's Golden Chaff	"	"	"	56.0
Prize Taker	"	"	"	54.9
Superlative	"	"	"	54.8
Forty Fold	"	"	"	52.2
Early Genesee Giant	Bearded	"	"	51.3
Egyptian Amber	"	White	Red	50.2
Russian Amber	"	"	"	50.2
Imperial Amber	"	Red	"	50.1
Paramount	Bald	"	"	49.9
Genesee Reliable	Bearded	White	"	49.6
Turkey Red	"	"	"	49.1
Treadwell	"	"	White	48.7
Harvest King	Bald	Red	Red	48.5
Rudy	Bearded	White	"	48.4
McGarvin	Bald	Red	"	48.3
Kentucky Giant	Bearded	White	"	48.0
Michigan Amber	"	"	"	48.0
Buda Pesth	"	"	"	47.9
Early Red Clawson	Bald	Red	"	47.9
Amherst Isle	Bearded	White	"	47.7
Geneva	"	"	"	47.4
Economy	Bald	"	"	46.7
Bulgarian	Bearded	"	White	45.6
Tuscan Island	"	"	Red	45.3
Tasmania Red	"	Red	"	44.9
McPherson	Bald	White	"	44.6

It will be noticed that each of the six highest yielding varieties have beardless heads, red chaff and white grain. The seven highest yielding varieties are white, and with one exception the fourteen lowest yielding varieties are red-grained.

The American Banner is identical in all essential characteristics with the Dawson's Golden Chaff.

The variety of winter wheat known as "No. 6" closely resembles in appearance the Dawson's Golden Chaff, except that the head is less tapering and the upper

portion of the straw is somewhat colored. In the average of nine years' experiments at the College it has yielded fully equal to the Dawson's Golden Chaff and has produced grain which is of somewhat better quality for bread production. The No. 6 variety was originated by Ira W. Green, at Avon, N.Y., and is at present the most popular winter wheat grown in the Genesee Valley, New York State. This wheat is also grown under different names, including "Gold Coin."

To supplement the seed wheat in Ontario, the writer went to New York State and made special arrangements by which a good supply of the best seed obtainable of No. 6 wheat was secured from farms in the western section of the Genesee Valley. This wheat was cleaned at the local elevators and carefully recleaned at Niagara Falls. The wheat was then distributed in car load lots this autumn to Hamilton, Meaford, Napanee, Bolton, Toronto, Mitchell, St. Mary's, Dundas,

The O. A. C. No. 104 variety of Winter Wheat with its two parents, the Dawson's Golden Chaff and the Bulgarian.

Streetsville Junction, and Caledonia. The record of this new importation will be watched with interest in these different localities.

According to the Monthly Bulletin on Agricultural Statistics for the Dominion of Canada for June, 1918, the number of acres of winter wheat in Ontario was given as 277,200 in 1918, and as 656,500 in the year previous. This reduction was largely due to adverse weather conditions at the time of seeding in the autumn of 1917 and to the exceptionally severe winter which caused much killing. It is estimated that 56 per cent. of the winter wheat of Ontario was ploughed down in the spring of 1918. According to the reports of the Bureau of Industries for

Ontario the average number of acres of winter wheat for the past thirty-six years has been 825,923.

The results of twelve separate tests made at the College show an average increase in yield of grain per acre of 6.8 bushels from large as compared with small seed, of 7.8 bushels from plump as compared with shrunken seed, and 35.6 bushels from sound as compared with broken seed. Seed which was allowed to become thoroughly ripened before it was cut produced a greater yield of both grain and straw and a heavier weight of grain per measured bushel than that produced from wheat which was cut at any one of four earlier stages of maturity.

In each of two years when winter wheat was sprouted in the fields, germination tests of the grain were made. The following results show the average percentages of germination from each selection: Skin over germ, unbroken, 91; skin over germ, broken, 76; sprouts one-quarter inch long, 30; and sprouts one inch long, 18. Not only were the sprouted seeds low in germination, but the plants produced were very uneven in size.

In the average of eight separate tests, land on which field peas were used as a green manure yielded 6.5 bushels of wheat per acre more than land on which buckwheat was used as a green manure.

In the Experimental Department, winter wheat which has been grown on clover sod has yielded much better than that which has been grown on timothy sod.

In the average of five years' experiments varieties of winter wheat gave practically the same results when sown separately as when sown in combination.

Sheaf of O. A. C. No. 104 Winter Wheat.
(Reduced to one-eighth.)

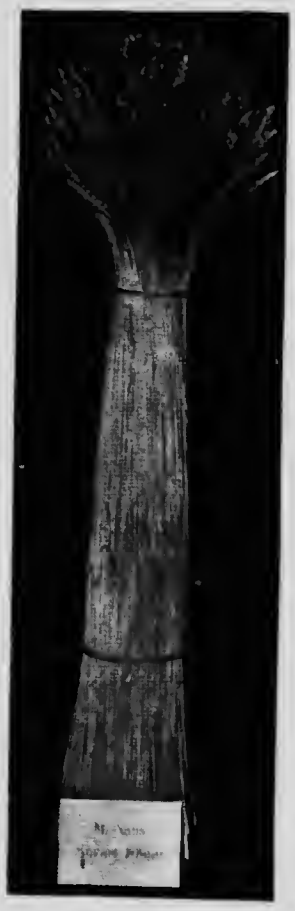
New Winter Wheats Originated at the O. A. C.

With the object of originating better varieties than those already in cultivation, crosses have been made between Dawson's Golden Chaff and some of the varieties of particularly high quality for bread production such as Tasmania Red, Crimean Red, Turkey Red, Buda Pesth, Bulgarian, and Imperial Amber. In the average tests for five years crosses between the Dawson's Golden Chaff and the Tasmania Red, Turkey Red and Bulgarian have each surpassed in average yield of grain the highest yielder of all the named varieties.

A cross made between the Dawson's Golden Chaff and the Bulgarian has sur-

nished a new variety which in eight years has surpassed both its parents in average yield per acre and is about equal to the Bulgarian in bread production. This variety has been given the name of "O. A. C. No. 104." The following gives the average results of the O. A. C. No. 104 in comparison with each of its parents for a period of **Eight Years:**

Varieties.	Weight per Measured Bushel (pounds.)	Yield per Acre.	
		Straw (tons.)	Grain (bushels.
O. A. C. No. 104	60.1	2.64	45.7
Dawson's Golden Chaff	58.4	2.29	42.4
Bulgarian	59.3	2.37	36.6



Sheaf of Marquis Spring Wheat.
(Reduced to one-eighth.)

In the experiments at the College the O. A. C. No. 104 proved to be one of the hardiest varieties in the past year, when so much damage was done by winter killing. It has been distributed throughout Ontario in connection with the co-operative experiments in each of the past three autumns. In each of the two years for which we have returns it has proven both productive and popular with the experimenters.

The O. A. C. No. 104 variety is not yet obtainable in large quantities, but there will probably be some seed available from the co-operative experimenters by next autumn.

SPRING WHEAT.

The area of spring wheat grown in Ontario was 351,423 acres in 1918, 182,957 acres in 1917, 144,305 acres in 1916, 162,142 acres in 1915, 118,607 acres in 1914, and 116,581 acres in 1913. Although there had been a general decrease in the acreage of spring wheat from 1884 to 1913, it will be seen that the increase during the past five years has been quite marked. It is estimated that the total production of spring wheat in Ontario for 1918 is 8,186,191 bushels, the yield per acre being 23.3 bushels. As spring wheat has done so well during the past year throughout the Province of Ontario it is quite probable that there will be a considerable acreage devoted to this crop in the next few years. The crop requires about the same amount of labour as oats, barley, rye or buckwheat and considerably less labor than any of the cultivated crops.

Spring wheat can be grown successfully on a variety of soils. It thrives

particularly well, however, on well drained, rich loam containing a fair amount of decaying vegetable matter. Fertile clay soils when well drained usually give satisfactory results in spring wheat production.

In crop rotations such as those followed in Ontario, spring wheat fits in very nicely. In experiments conducted at the Ontario Agricultural College it has given good results when sown after corn, potatoes, swede turnips, fall turnips, carrots and rape. It usually gives satisfactory results when sown on sod land ploughed in the autumn or on land which has grown beans or peas, and which has had thorough preparation so as to permit of early seeding in the spring. Spring wheat forms one of the very best nurse crops with which to seed grasses and clovers, either singly or in combination.

Twenty-one varieties of spring wheat, exclusive of Emmer, Spelt and Einkorn, have been under uniform tests at the Agricultural College in each of the past six years. The experiment was conducted on what might be termed an average clay loam. In part of the years the plots were located on a ridge and in other years on lower, sloping land. The following table gives the average results of the **Six Years'** experiment with each of twenty-one varieties of spring wheat:

Varieties.	Bearded or Bald.	Average Height. (inches)	Per Cent. Rust.	Days to Reach Maturity.	Weight per Measured Bushel. (pounds)	Yield per Acre.	
						Straw (tons.)	Grain (bushels.)
Flour Wheats—							
Saxonka	Bearded	48	9	117	60.66	2.61	**40.54**
Climax	"	47	6	117	59.72	2.68	**40.51**
Pringle's Champion	"	48	7	117	60.66	2.60	**39.70**
Marquis	Bald	41	10	113	61.14	2.13	**39.08**
Minnesota No. 163	"	45	7	117	58.83	2.42	**38.65**
Herison Bearded	Bearded	46	6	117	61.28	2.50	**38.38**
White Russian	Bald	44	7	116	58.18	2.45	**37.97**
Hungarian	Bearded	42	9	113	61.93	2.36	**37.73**
Red Fern	"	48	8	116	60.28	2.44	**37.46**
Red Fife	Bald	44	8	116	58.99	2.40	**37.04**
White Fife	"	42	9	118	57.98	2.32	**36.15**
Colorado	Bearded	47	7	116	60.27	2.38	**35.54**
Prelude	"	36	12	104	62.21	1.67	**28.69**
Durum Wheats—							
Arnautka	Bearded	46	3	116	62.30	2.22	**41.55**
Rouuaifia	"	46	3	116	61.74	2.14	**40.55**
Wild Goose	"	47	3	116	61.75	2.28	**40.03**
Kubanka	"	47	4	116	61.56	2.20	**38.90**
Sorentina	"	46	4	114	60.74	2.14	**35.55**
Medeah	"	46	4	113	61.29	2.10	**34.00**
Turgid Wheat—							
Seven Headed	Bearded	47	11	118	58.31	2.33	**33.37**
Polish Wheat—							
Polish	Bearded	42	10	117	57.16	2.00	**26.19**

The Saxonka, the Climax and the Pringle's Champion, which occupy the three highest places in yield per acre of the flour wheats, are not grown extensively in Ontario. The Marquis variety of spring wheat which occupies fourth place in average yield per acre, is a hybrid wheat originated at the Central Experimental Farm, Ottawa, from crossing the Calcutta Hard Red and the Red Fife. It is not only a good yielder, but it is a wheat of excellent quality for bread production

and one which is increasing substantially in the Western Provinces and in Ontario. It occupies a somewhat similar position amongst the spring wheats as does the O.A.C. No. 21 barley, the O.A.C. No. 72 oats and the O.A.C. No. 61 spring rye amongst other classes of spring grain. Of the Durum wheats, the Wild Goose variety has been grown for many years in Ontario and is popular amongst the farmers. The Arnautka is very similar to the Wild Goose but is not grown much in Ontario under that name.

In each of the years 1915 and 1916, the varieties of spring wheat were milled and uniform quantities of flour were tested for bread production in the Bakery branch of the Chemical Department at the College. The leading varieties in volume of loaf are given in the following order: Prelude, Marquis, White Fife, White Russian, Hungarian and Minnesota No. 163. Those varieties which produced the lowest volume of bread were Polish, Seven Headed and Medeah. The Prelude, which came first in size of loaf, was also originated at the Central Experimental Farm. The Saxonka, which secured highest place of the flour wheats in average yield of grain per acre for five years, occupied fourteenth place in comparative size of loaf in the baking tests of two years, but in this respect slightly surpassed both the Pringle's Champion and the Climax varieties.

A new hybrid variety of spring wheat has been originated at our College by crossing the Red Fife and the Herison Bearded varieties, and it has given an average yield of grain of 42.2 bushels per acre per annum in the experiments for the last six years. This is a higher average yield per acre than any of the named varieties. In comparative size of loaf, from a definite quantity of flour, it was surpassed by nine of the twenty-one named varieties reported in the previous table. This new variety has not been distributed for general cultivation.

Tests have been made at the College in comparing the results in growing spring wheat after potatoes and fall turnips for each of three years, and after corn, swede turnips, carrots and rape for one year. The results show very good yields of spring wheat per acre after each of these cultivated crops, and particularly returns after potatoes and corn. It is of great importance to have land ploughed or cultivated in the autumn so as to permit of early seeding of the wheat in the following spring.

Spring wheat was sown at the College with a tube drill and broadcast by hand on well cultivated land at each of six different dates in each of five years. The results go to show that in yield of grain per acre of the five separate dates for which we have complete returns, the drilled grain gave the highest yields in the average of each of four dates, and the grain which was sown broadcast by hand gave the highest returns in the average of one date. In averaging the results for all dates of sowing, there was but slight difference in the returns from the two methods of seeding. If the land had been poorly prepared and lumpy, it is quite likely that the grain which was sown with the tube drill would have produced a considerably higher yield than that which was sown broadcast.

Emmer, Spelt and Einkorn.

In the case of each of three types or species of wheat, there is not a clear separation of the chaff and the grain in the process of threshing. These include

the emmer, the spelt and the einkorn. Emmer and spelt are used in some countries to a limited extent for flour production. When used for this purpose, however, speeial machinery is required for separating the chaff or the hull from the grain. In this country these grains are considered from the standpoint of the amount of feed which they will produce for farm stock. Emmer is considered about equal to barley for feeding purposes. The following table gives the average of **Thirteen Years'** results of each of four varieties of emmer and four varieties of spelt:

Classes of Crop.	Varieties.	Per Cent. of Hull (Average 12 Years.)	Per Cent. of Rust.	Per Cent. of Crop Lodged.	Weight per Measured Bushel. (pounds).	Yield per Acre.	
						Straw (tons).	Grain (pounds).
Emmer.....	Common.....	19.75	2	21	39.58	1.93	**2,779**
	Emmer No. 1529	19.54	2	14	39.17	1.89	**2,738**
	Russian	19.96	2	15	39.59	1.75	**2,712**
	Iowa	19.10	2	18	39.69	1.78	**2,680**
Spelt.....	Alstroum	28.65	13	4	27.40	1.52	**2,140**
	Red	28.14	10	7	27.83	1.53	**2,117**
	White Summer	29.17	13	3	27.26	1.56	**2,087**
	Triticum Spelta	26.07	10	14	29.35	1.57	**2,061**

A few years ago emmer was introduced by some of the seedsmen under the name of spelt and was advertised very extensively both in Canada and the United States, and most extravagant claims were put forward for this grain. The results of experiments conducted at Guelph are of value in giving some true and reliable information regarding the two species of grain and the comparative results of some of the varieties of each type. It will be seen that each of the four varieties of emmer gave a much higher average yield of both grain and straw per acre than each of the varieties of spelt. The percentage of hull of emmer is only about two-thirds as great as that of spelt and is only about two-thirds as great as the percentage of hull of the average variety of oats. Common emmer in yield of grain per acre has been a close rival to the best varieties of barley and the best varieties of oats. Throughout Ontario, however, in connection with the co-operative experiments, the O.A.C. No. 21 barley has given rather better results in grain production than Common emmer.

Varieties of Winter Rye.

In 1918 there were 112,726 acres of rye grown in Ontario. This includes the rye which was sown in the spring as well as that which was sown in the autumn. The latter, however, comprises the greater part of the rye crop of the Province. Four varieties of winter rye have been under test at the Ontario Agricultural College in each of the past **Fifteen Years.** The following gives the average results for the whole period:

Varieties.	Per Cent. of Crop Lodged.	Weight per Measured Bushel (pounds).	Yield per Acre.	
			Straw (tons).	Grain (bushels).
Mammoth White...	11	57.1	3.9	57.2
Washington	20	57.3	3.7	54.4
Common	11	57.4	3.8	53.3
Thousand Fold	18	57.0	3.8	52.9

The results show that all varieties of winter rye produced a high average yield of grain per acre. It should be understood that these have been grown on similar soil to that used for the other cereals under experiment. In many cases over Ontario, winter rye is sown on soil which is so poor that it will scarcely grow any other crop. If winter rye were sown under similar conditions as winter wheat over Ontario, the yields per acre would undoubtedly be higher than they are at the present time.

For seven years in succession the Petkus variety of winter rye has been included in the experiments and, with three slight exceptions has surpassed all other kinds in each of the seven years. The average yield per acre per annum of the Petkus winter rye surpassed that of the next highest yielding variety by four bushels in the seven years' test.

Varieties of Spring Rye.

Spring rye is not grown as extensively in Ontario as that which is sown in the autumn. Some farmers, however, grow a limited quantity of this crop. An experiment has been conducted at the College with four varieties throughout the past **Eleven Years** with the following results:

Varieties.	Yield of Straw per Acre (tons).	Weight of Grain per Measured Bushel (pounds).	Yield of Grain per Acre by Weight (bushels).
O. A. C. No. 61 ..	2.26	54.1	31.6
Saatroggen.....	2.29	54.4	30.7
Common.....	2.13	54.1	27.8
Prolific.....	2.08	54.2	27.7

Some years ago a valuable variety of winter rye was obtained from Germany. This was gradually converted into a spring variety in the tests at the College and is reported in the foregoing table as Saatroggen. From the Saatroggen rye, a number of the choice plants were selected and were grown separately. The O.A.C. No. 61 variety was originated from one of these selections. Its history, therefore, traces back to a single selected plant obtained at the College from the Saatroggen variety.

Varieties of Buckwheat.

In 1918 there were 223,662 acres of buckwheat grown in Ontario in comparison with 153,457 acres in 1917. The average number of acres of buckwheat in Ontario for the past 36 years has been 118,648 acres per annum. The following table gives the average results of **Thirteen Years'** tests with each of four varieties of buckwheat grown in the Experimental Department.

Variety.	Weight per Measured Bushel (pounds).	Yield per Acre.	
		Straw (tons).	Grain (bushels).
Rye or Rough	50.1	2.4	**30.3**
Common Grey	45.9	3.0	**21.7**
Silver Hull	50.2	3.0	**21.2**
Japanese	45.0	3.2	**21.2**

In each of ten out of the thirteen years, the Rye or Rough buckwheat gave a higher yield of grain per acre than any one of the three other varieties. This buckwheat is not grown extensively in Ontario but it has been produced to a considerable extent in the Maritime Provinces and especially in Nova Scotia. The flour of the Rye buckwheat has a slightly yellowish color. The grain itself is not as attractive as that of the Silver Hull variety and it is possible that the hull may be a little thicker than that of the last named variety.

Varieties of Field Peas.

The number of acres of field peas in Ontario in 1917 was 90,322 and in 1918, 113,862. In the past year the total production of peas in the Province amounted to 2,381,937 bushels and the average yield per acre was 20.9 bushels as against 16.7 bushels in 1917, 13.0 bushels in 1916, and 19.1 bushels as the average of the past thirty-six years. In order to give as much assistance as possible, the College has tested a large number of varieties of field peas obtained from different parts of the world to determine the most suitable kinds for grain production in Ontario. As in the case of other kinds of grain the lower yielding varieties have been dropped after being carefully tested and only the most productive kinds have been retained for more than five years. The following table gives the average results of experiments for the past **Five Years** for each of nineteen varieties which have been tested at the College:

Varieties.	Color of Grain.	Per Cent. of Peas Weevilly.	Days to Mature.	Length of Vines (ins.).	Weight per Measured Bushel (lbs.).	Yield of Straw per Acre (tons).	Yield of Grain per Acre (bus.).
Shannon Peas	Light Brown	41	104	49	56.3	1.70	**37.97**
Spanish No. 22077 (Wash.)	Brown	14	106	43	66.9	1.72	**36.50**
No. 18806 Green (Wash.)	Green	21	101	36	59.7	1.28	**35.27**
Small Blue Peas	Blue	12	104	29	62.1	1.19	**32.23**
Potter	White	10	112	51	61.3	1.58	**32.07**
Concordia Blue	Blue	9	110	30	62.5	1.35	**31.61**
Clamart	White	9	110	47	61.6	1.50	**31.22**
New Canadian Beauty	White	15	113	46	61.9	1.78	**31.11**
Black Eyed	Smoky White	9	114	47	61.1	1.66	**30.61**
Arthur	White	7	111	38	63.1	1.44	**30.35**
White Wonder	White	10	107	26	62.8	1.35	**30.48**
White Marrowfat	White	16	114	47	61.9	1.71	**28.39**
Early Britain	Light Brown	6	112	45	60.4	1.65	**26.65**
Prussian Blue	Bluish Green	13	116	49	62.5	1.72	**26.49**
No. 20467 (Wash.)	Brown & Green.	8	110	46	60.9	1.73	**25.03**
Golden Vine	White	8	115	50	63.1	1.75	**24.14**
Multipliers	White	9	116	52	62.9	1.81	**24.10**
No. 12887 (Wash.)	Brown	14	113	44	61.7	1.64	**23.13**
Solo Peas	Greenish Brown.	8	111	45	60.9	1.48	**22.14**

The Shannon variety of field peas which comes at the head of the list is a light brown pea and the pods when green are dark purple in color. Although the Shannon pea has given a comparatively large yield per acre it has been surpassed by some of our new hybrid varieties in the tests of the past four years. As for instance, one hybrid surpassed the Shannon in yield of grain per acre by 6.9 bushels in 1915, 7.5 bushels in 1917, and 6.8 bushels in 1918 but in 1916 this hybrid was surpassed by the Shannon by an average of one bushel per acre. More information will be given regarding our new hybrid peas in the near future, providing the results prove satisfactory in every way and the new varieties can be increased so as to be included in our co-operative experiments throughout Ontario.

It will be observed that the longest strawed varieties are the Multipliers, the Potter and the Golden Vine. These are particularly suitable varieties for mixing with oats in the production of green fodder or of hay from which satisfactory results have been obtained by using a mixture of one bushel of peas and two bushels of oats or a total of three bushels per acre.

Varieties of Field Beans.

The average acreage of beans in Ontario for the past thirty-six years according to the Ontario Bureau of Industries Report is 47,046, and the area in each of the past two years has been over 100,000 acres. The average yield of beans per acre in Ontario for the thirty-six year period has been 16.3 bushels, but the last four years being abnormal in respect to high rainfall have given less than normal yields. Those counties of Ontario which have given the greatest attention to the production of field beans are Kent, Huron, Elgin, Welland, Middlesex and Norfolk. The following gives the average weight per measured bushel and yield of beans per acre of each of seven varieties tested over **Seventeen Years**:—

Varieties.	Weight per Measured Bushel (pounds).	Yield of Grain per Acre per Annum (bushels).
Pearce's Improved Tree	64.3	21.9
Scholfield Pea	65.2	21.0
White Wonder	64.6	19.8
Medium or Navy	64.9	19.6
Marrowfat	64.6	19.2
Small Pea	64.5	17.5
Large White Haricots	59.8	17.1

The beans here reported are all white in color and are all suitable for commercial purposes. The Pearce's Improved Tree bean which comes at the head of the list will probably not be grown as much in general cultivation as the Small White Pea variety owing to the fact that it is a little later in reaching maturity. Selections of the Pearce's Improved Tree beans are now being made with the object of retaining the good yielding quality and hastening somewhat the maturity of this valuable variety.

In the average results for the past five years in which we have had rather abnormal weather conditions, some of the varieties which come highest in yield per acre are Marrowfat, Pearce's Improved Tree, White Wonder, and New Prize Winner. The lowest yielders of the seventeen varieties for the five-year period are: Wardwell Kidney, Black California Pea, Yellow California Pea and White Kidney. In 1918

those varieties which gave the highest yields per acre were Marrowfat and Pearce's Improved Tree and those which gave the lowest yields per acre were the Black California Pea, Wardwell Kidney, and Yellow California Pea.

A considerable amount of work is being carried on not only to improve the

Plant of Pearce's Improved Tree Bean.

productiveness of beans by selection of individual plants but also to try and secure strains of varieties as immune as possible to the attacks of anthracnose and other diseases which are troublesome to this crop.

Varieties of Soy or Soja Beans.

Numerous experiments have been conducted at the College with different varieties of Japanese beans, usually termed Soy or Soja. This class of crop has not been grown extensively in this country but is being used to a limited extent by some of the progressive farmers. Many of the varieties which are grown in the central or southern States are entirely too late to mature in this Province. We have been testing some of the most promising varieties obtained from Japan, Russia and the United States with the idea of ascertaining whether or not any of these sorts would give satisfactory results in the Province. Seed of one or two of the best varieties has been distributed for co-operative experiments in the spring of the year for a number of seasons.

Soy beans furnish exceedingly rich feed for farm stock and the plants may be cut and converted into silage or they may be allowed to ripen for the production of grain. Upwards of thirty varieties have been under experiment at the College. In 1918 eighteen varieties and selections of soy beans were grown under similar conditions in the experimental grounds at the College. Of this number twelve varieties have been grown in competition in each of the past **Five Years** in succession, and the following table gives the average number of pounds per measured bushel and the average number of pounds of grain per acre of each of the varieties:

Varieties.	Average Number of Pounds per Measured Bushel.	Average Number of Pounds of Grain per Acre.
O. A. C. No. 111	54.9	946
Buckshot (No. 17251, Wash.)	55.9	945
Habara (No. 20405, Wash.)	56.0	940
Chernie (No. 18227, Wash.)	58.1	927
Brown	58.5	918
Quebec No. 92	58.5	886
Early Yellow	56.1	851
Tsurunoko	58.1	839
Quebec No. 537	56.8	815
O. A. C. No. 81	58.0	805
Ito San	57.0	800
Medium Green	....	370

Three varieties were obtained through the Department of Agriculture at Washington and these occupy second, third and fourth places in the list in average yield per acre for five years. All varieties, however, were surpassed by a selection made at the College which was started from an individual plant selected from the Early Yellow variety. We obtained two selected varieties from the Macdonald College, Quebec, under the name of Quebec No. 92 and Quebec No. 537. The former occupies sixth and the latter ninth place in average yield of grain per acre. In 1918, the highest yield in the duplicate experiment was obtained from the Habara.

In each of the past few years two varieties have been distributed for co-operative experiments. The Brown variety has proven early and in some seasons and under certain conditions has given a little higher results than the O.A.C. No. 81. In normal years the O.A.C. No. 81 has surpassed the Brown variety.

Hairy Vetches and Spring Vetches for Seed.

Common spring vetches have been grown in Ontario to a limited extent for a good many years, especially for mixing with oats and peas for the production of fodder. Hairy vetches, however, are a more recent introduction and may be grown in the fall or in the spring. They are used for the production of green fodder and of hay and as a cover crop in orchards. The vetches are leguminous crops and furnish feed which is rich in nutritive constituents. The Common vetches have been tested at the College and when grown separately have usually proven a failure from the standpoint of seed production.

The seed of the Hairy vetches has been mostly imported and is very expensive. It has been found through experiments that the seed can be grown in Ontario with a fair amount of satisfaction. In experiments covering a period of seventeen years in which Hairy vetches were grown in the autumn for the production of

seed in the following year an average of 7.85 bushels of seed per acre has been obtained. In three of these years the yield was upwards of 18 bushels per acre per annum and in four other years less than two bushels per acre. In 1913 the crop was a failure owing to the fact that it was killed out in the winter and the early spring more than any other year during the entire experiment. In 1918 the yield of seed was 11.66 bushels per acre. The Hairy vetches which have been grown at the College for several years have produced about forty per cent. greater yields of seed per acre than the Hairy vetches which have been imported more recently.

In the southern part of Ontario some farmers are sowing rye and vetches together. The rye tends to keep the vetches from the ground and to increase the production of a good quality of seed. This seems to give rather better satisfaction than when the Hairy vetches are grown by themselves. In experiments conducted at the College during the past three years interesting results have been obtained by sowing in the autumn Hairy vetches with each of three kinds of grain, viz., winter wheat, winter rye and winter emmer. The highest yield of vetch seed has been obtained from the Hairy vetches and the winter rye sown in combination.

Occasionally Hairy vetches are sown in the spring of the year for seed production but the results are not nearly as satisfactory as those obtained from the autumn sowing. The autumn sowing usually produces about double the amount of seed obtained from the spring seeding.

Grass Peas.

Some years ago grass peas were grown as a regular grain crop in Ontario. They were also used to a limited extent for the production of fodder. The grain was ground into meal and the meal which was rich in valuable food constituents was used in small quantities to increase the value of the meal ration of other grains.

The grass pea is an annual legume. The stems of the plants are flat and the whole crop, when used as a green fodder, is greatly relished by animals. The flowers are white in color and the grain is angular in form, very hard, and immune to the attacks of the pea weavil, commonly called pea bug.

In the experimental tests over a period of ten years, the yield was about 12 bushels per acre. In 1918 on a plot of about a quarter of an acre, the yield was at the rate of 16 bushels per acre. The grass peas thrive best when the weather is comparatively warm with not a very large amount of rainfall. As some of the recent years have had an abnormally large amount of rain, this crop has not grown as successfully as it did a few years ago. Many farmers who formerly grew grass peas as a farm crop have discarded them but they are still grown to a limited extent.

Cow Peas.

Nearly all the varieties of cow peas are quite unsuitable for this Province. In years past, we have grown many varieties but practically all have required too long a season for development and the crop has usually been a failure. The two varieties grown in 1918, viz., the Whip-poor-will and Wonderful, did not even produce pods before the plants were frozen in the autumn. Although much is said and written in regard to the value of the cow peas for the southern states, we must remember that the conditions in Ontario are quite different. The farmers of Ontario should give their attention to those classes of farm crops which will prove

the most suitable for their conditions. The common red clover occupies about the same position in the agriculture of Ontario as do the cow peas in the southern states.

Varieties of Corn for Grain Production.

In 1918, 195,310 acres were used in the Province of Ontario for the production of corn for husking. The highest acreage used for husking corn in Ontario in the last thirty-seven years occurred in 1903 when 378,924 acres were used for this purpose. The tendency during the past few years has been to increase the fodder or the silo corn and decrease somewhat the corn for husking purposes. The area for husking corn in 1918 was lower than in any previous year since 1892. This will probably be accounted for largely by the scarcity of good seed and the lack of labor, as a large amount of labor is required in cultivating the corn and in husking the crop.

Experiments have been conducted at the College with a large number of varieties of corn, some of which do not ripen sufficiently to obtain satisfactory yields of matured seed when grown over a series of years. In the average of ten years' experiments the following yields in bushels per acre have been obtained by those varieties which have usually ripened the grain fairly well: Early California Flint, 52.1; Hammond's White Cap Yellow Dent, 49.1; Salzer's North Dakota, 48.9; Duke's Longfellow, 45.3; Zavitz' White Cap Yellow Dent, 43.6; Genesee Valley, 42.1; Duke's Compton's Early, 40.9. These yields are comparatively low owing to two or three poor seasons for grain production for the different varieties of corn. In 1918, the highest number of bushels per acre were obtained from Early California Flint, 40.8; Hammond's White Cap Yellow Dent, 39.4; and Salzer's North Dakota, 37.3. It will, therefore, be seen that the same three varieties gave the highest yield per acre in 1918 as in the comparative test for ten years. Such varieties as the Leaming, Wisconsin No. 7, and Mammoth Southern Sweet, do not ripen sufficiently well at Guelph to give satisfactory returns for grain production.

Some interesting and valuable experiments are under way in testing the comparative value of planting corn by the use of six different quantities of seed per acre in the case of both flint and dent varieties. By planting the rows equal distances apart and the plants at one inch, two inches, three inches, six inches, nine inches, and twelve inches apart, some valuable results are being secured as the chemical analyses as well as the actual yields per acre are being obtained. This experiment will likely continue for two or three years more before the results are compiled and ready for publication.

Another experiment is under way in which large, medium, and small kernels of corn are being tested for crop production. Up to the present time the large kernels have produced the largest, most vigorous and most productive plants.

The results of varieties of corn for fodder and the silo are presented in the latter part of this bulletin.

Varieties of Sorghum for Seed.

More than thirty varieties of sorghum have been tested at the College within the past few years. These include different varieties of broom corn, saccharine sorghum (also called sugar cane), kaffir corn, Jerusalem corn, milo maize, etc. There are marked differences between the classes of sorghum and also between the varieties of the different classes. The sugar canes or more properly sugar

sorghums contain a high percentage of sugar, while all of the other types of s[illegible]um are non-saccharine.

In 1918 there were eighteen varieties of sorghum under experiment for seed production. Owing to an abnormal season of high rainfall the seed production was almost a failure. The greatest yields were produced by the Black Amber sugar cane and by the Ontario grown Early Amber sugar cane. As a rule, however, the highest yields have been produced by the broom corns, as they are somewhat earlier than the sugar sorghums. Three varieties of sorghum which have been grown for seed production in each of ten years have given an average yield of seed per acre as follows: Improved Evergreen Broom Corn, 1,025 pounds; California Golden Broom Corn, 1,017 pounds; and Early Japanese Broom Corn, 1,009 pounds.

The sorghums appear to do particularly well on warm, rich, sandy loams. They are sown and cultivated in much the same way as corn but the rows are usually placed a little closer together. The Early Amber sugar cane which has been grown in Ontario for some years and which has had a certain amount of selection is at present the most promising of the saccharine sorghums.

Sunflowers for Seed.

Sunflowers have been grown to a limited extent for the production of seed. The seed of the sunflowers has been quite highly recommended as a poultry feed. Evidently but little work has been done, however, in the testing of different varieties of sunflowers as crop producers at experiment stations in the United States or in Canada other than at Guelph. A number of years ago, seven varieties of sunflowers were obtained and grown under uniform conditions on our experimental grounds. In a short time some of these varieties were dropped but those which made the highest records were continued in the experiments. Sunflowers are planted in rows about forty inches apart and are cultivated in much the same way as corn, the plants being about [illegible] foot apart in the rows. The following table gives the average height and the aver[illegible] yield of grain per acre for **Eighteen Year** in the case of each of three varieties:

Varieties.	Height.	Yield of Seed per Acre.	
		Bushels. (20lbs.per bush.).	Pounds.
Black Giant	105	72.7	**1455**
Mammoth Russian....	100	71.5	**1430**
White Beauty.....	89	70.3	**1406**

The sunflowers are very hardy and sometimes produce good returns when other crops are partial failures.

Varieties of Flax for Seed and for Fibre.

Flax growing in Ontario has received new impetus recently owing to the limited supply in Europe and the great demand for the flax fibre for use in the manufacture of the covering for the wings of aeroplanes. Although the requirements for this purpose will likely be reduced greatly it is quite probable that the demand

for flax fibre in Ontario will be considerable until the European countries reach their normal condition of flax production. We have had under experiment at the College seven varieties and strains of flax in each of the past eight years. The following table gives the average results of each variety for the **eight-year** period:

Varieties.	Weight per measured Bushel (pounds).	Yield of Flax Seed per acre (bu. 56 lbs.)	Yield of Flax Straw per acre (tons).
O. A. C. No. 114	54.6	16.7	2.35
Minnesota No. 25	55.2	21.2	2.26
Primost.....	55.0	20.0	2.15
Common	53.6	19.9	2.15
Argentine.....	53.3	18.3	2.10
O. A. C. No. 116	54.1	19.7	2.09
Manitoba.....	53.7	19.1	2.04

In 1918, nine varieties of flax were under test, the Minnesota No. 25 producing the highest and the Lavanian Long Stem the second highest yield of fibre straw per acre. The greatest yield of seed was produced by the O. A. C. No. 116 and the second highest yield of seed by the Minnesota No. 25.

In each of the past fourteen years Common Ontario and Common Manitoba flax have been under test. The Ontario strain gave an average of 2.45 tons and the Manitoba strain 2.41 tons of fibre straw per acre per annum for the fourteen-year period. The Manitoba seed gave an annual average yield of 19.6 and the Ontario seed of 19.2 bushels per acre, 56 pounds being allowed as the standard weight per bushel.

Different Quantities of Flax Seed per Acre.

In each of five years four varieties of flax were sown at the rate of one peck, two pecks, three pecks, eight pecks, twelve pecks and sixteen pecks per acre, making in all twenty-four plots in the experiment each year. The following table gives the average results of the experiments for the **five-year** period:

Amount of Seed Sown.	Straw or Fibre Producing Material.		Weight per Measured Bushel.	Yield of Grain per Acre.	Yield of grain per acre, less amount of seed sown.
	Height of Crop.	Yield of Straw.			
	inches.	tons.	pounds.	bushels.	bushels.
1 peck per acre	29	1.55	54.9	14.9	14.6
2 pecks " "	29	1.68	54.7	15.2	14.7
3 " " "	29	1.96	54.8	18.6	17.8
8 " " "	28	2.24	54.6	19.9	17.9
12 " " "	27	2.35	54.3	20.2	17.2
16 " " "	26	2.24	54.2	18.0	14.0

It will be seen that the longest straw was produced when less than one bushel of seed per acre was used. It will also be noticed that the greatest yield of straw was produced when two bushels or more were used per acre. It should be remembered

that the thin seeding encourages a considerable amount of branching of the stems, while the thick seeding produces straight stems with but little branching.

In the average yield of seed per acre it will be seen that where twelve pecks of seed were used, slightly over twenty bushels of flax seed were obtained. Where the amount of seed used, however, is subtracted from the amount of seed produced, the greatest yield has resulted from eight pecks per acre, which is only slightly more than that obtained from three pecks per acre.

Flax Production and Soil Fertility.

The actual amount of fertilizing constituents taken from the soil by different crops is an important matter from the farmer's standpoint. To secure this information it is necessary to have a knowledge of both the yields and the chemical composition of the crops. Unfortunately, the statistics gleaned by both the Dominion and the Provincial Governments do not furnish sufficient data for these calculations. In 1918 the first estimate of flax was made by the Bureau of Industries and was 12.3 bushels per acre. No estimates have been made for the straw of flax or of cereals. At the Agricultural College, however, accurate determinations are made from year to year of the yields of both grain and straw per acre of the different farm crops.

Flax, winter wheat, oats and barley have been grown under similar conditions in the experimental grounds at Guelph in each of the past twelve years. The varieties used for these determinations of the comparative exhaustiveness of soil fertility were Common flax, Dawson's Golden Chaff winter wheat, Banner oats and Mandscheuri barley. In each case the chaff was included with the straw. The flax was grown in duplicate plots each year with an average of 77 pounds of seed per acre, and the average returns, therefore, represent twenty-four tests in the twelve-year period.

For the chemical composition the figures used were obtained from the 1915 edition of "Feeds and Feeding" by Henry and Morrison with the exception of those of flax straw which are not given in that publication. For the chemical composition of the flax straw use has been made of the figures determined by Kennedy in his thesis prepared at the Ontario Agricultural College. The flax was obtained from the Field Husbandry Department, and it was analyzed in the Chemical Department of this institution. The following gives the average annual yields for the **Twelve-Year** period and the amount of fertilizing constituents obtained through the sources previously indicated:

Varieties.		Yield per Acre.		Nitrogen. (N).		Phosphoric Acid. (P_2O_5).		Potash. (K_2O).	
		Bushels and Tons.	Pounds.	Per Cent.	Total in Crop (lbs.)	Per Cent.	Total in Crop (lbs.)	Per Cent.	Total in Crop (lbs)
Common Flax	Seed	18.3	1024	3.62	37.1	1.50	15.4	.95	9.7
	Straw	2.45	4900	.72	35.3	.31	15.2	1.02	50.0
Dawson's G. C. Winter Wheat	Seed	43.2	2590	1.87	48.4	.85	22.0	.52	13.5
	Straw	2.22	4440	.50	22.2	.13	5.8	.74	32.9
Banner Oats	Seed	75.0	2550	1.98	50.5	.81	20.7	.56	14.3
	Straw	2.07	4140	.58	24.0	.21	8.7	1.50	62.1
Mandscheuri Barley	Seed	63.4	3043	1.84	56.0	.85	25.9	.74	22.5
	Straw	1.89	3780	.56	21.2	.18	6.8	1.20	45.4

The yields of all four crops are considerably larger than the average yields of the province. It should be clearly understood, however, that the experiments have been conducted under uniform conditions. The crops were grown during the twelve years immediately previous to 1917. The land received a four year's rotation during which three crops were removed from the soil. Farmyard manure was applied every four years at the rate of twenty tons (about twelve good sized loads) per acre. No commercial fertilizers were used with any of these crops.

In the growing of flax both the seed and the straw are frequently sold outright. The market value of these crops per acre, however, are usually the lowest for oats and barley and decidedly the highest for flax. It is interesting to note that the value of fibre per ton and of seed per bushel of flax in Ontario in each of three years was as follows: 1915, $400, $1.60; 1916, $600, $3.00; and in 1917, $1,100, $5.50.

According to the Monthly Bulletin of Agricultural Statistics for the Dominion of Canada for February, 1918, the fibre yield of flax for Western Ontario for 1917 was 350 pounds per acre, valued at 55 cents per pound, and the yield of seed 9 bushels per acre, valued at $5.50 per bushel. This would give a return from both the seed and the fibre of $212 per acre.

Varieties of Millet for Seed Production.

Millet sometimes forms an important crop in Ontario, more particularly to supplement the hay crop when it is found that there are poor prospects for a good crop of hay. It is grown largely for the production of green fodder but is also grown to a limited extent for the production of seed. Twenty varieties were under experiment in 1918 and the yield of seed varied from 5.9 to 30.4 bushels per acre. Those varieties which produced more than twenty-six bushels per acre were the Steele Trust, Holy Terror Gold Mine, Golden Wonder, and a selection of the Siberian. The following are the average results of each of seven varieties of millet over a period of **Thirteen** years:

Varieties.	Weight per Measured Bushel. (lbs.).	Yield of Seed per Acre. (bush.).
Siberian	53.3	43.9
Steele Trust	54.2	42.7
Hungarian	53.5	40.0
Holy Terror Gold Mine	51.0	36.7
Golden Wonder	52.1	35.1
Common	53.8	32.0
German or Golden	53.1	31.8

In the average of five years' experiments with each of sixteen different varieties the greatest yields were produced by Kursk, 36.9; Golden Wonder, 36.1; Siberian No. 92, 35.1; and Siberian No. 91, 34.1 bushels per acre. The Kursk, which is evidently also called the Canary Bird millet has given practically four bushels of seed per acre more than the Hungarian Grass, and about twelve bushels per acre more than the Common millet. This variety was obtained in 1910 from Northrup, King and Company, Minneapolis, Minnesota. Both the Kursk and the Siberian millets have given excellent results for seed production in the tests at the College.

Experiments with Potatoes.

A bulletin of eighty-five pages on "Potatoes" was prepared by the writer and was printed by the Ontario Department of Agriculture in 1916. Copies of this bulletin can be obtained by request to the Department of Agriculture, Parliament Buildings, Toronto. The bulletin deals in a comprehensive way with all experiments conducted at the College with the potato crop for a period of twenty-six years and includes the following: Soils, Rotations; Cultivation of Soil, and Cutting and Planting Potatoes; Change of Seed; Varieties, and Variety Tests; Description of each of Ten Varieties of Potatoes; Early Varieties for Early Use; Co-operative Experiments with Varieties of Potatoes; Table Quality of Potatoes; Potato Improvement, including Selection and Hybridization; Planting Potatoes at Different Dates; Different Exposures of Seed Potatoes for Three Weeks Before Planting; Planting Whole and Cut Potatoes; Planting Sets of Different Sizes, with One Eye in Each Set; Planting Sets of Different Sizes and at Different Distances Apart; Planting Sets of Equal Size with a Varying Number of Eyes; Planting Single Eyes from Different Parts of the Seed Tubers; Planting One, Two and Four Potato Sets per Hill; Influence of Plaster and Lime when Sprinkled on Freshly Cut Seed Potatoes; Planting Potato Sets at Different Times After Cutting; Planting Seed Potatoes at Different Depths; Methods of Cultivation; Exposure in the Sun of Seed Potatoes and of Furrows at Time of Planting; Application of Manures and Fertilizers; Co-operative Experiments with Potatoes and Fertilizers; Spraying with Bordeaux Mixture for the Prevention of Late Blight, Early Blight and Tip Burn; the Resistance of Potatoes to Rot; Rot in Stored Potatoes of Different Varieties; Treatment for the Prevention of Rot in Stored Potatoes; Treatment for Potato Scab; Suggestions for Eradicating Potato Diseases from an Ontario Farm; Ontario Free from Some Serious Potato Diseases; Treatments for the Colorado Potato Beetle; Methods of Handling the Potato Crop for Satisfactory Results; Cost per Acre of Growing Potatoes, and Organized Agencies in Connection with Potato Production.

In the results of experiments conducted at the Ontario Agricultural College it has been found that the yield of potatoes has been increased by the use of tubers grown in certain northern districts, or by the use of home-grown seed potatoes which have not reached maturity. The real value of northern-grown seed potatoes appears to be that they have been produced in a comparatively cool climate, with no setback in development caused by droughts in July or August, and the vines are usually green when the potatoes are harvested. There are many illustrations of the value of northern-grown seed as the result of experiments and of the experience of practical potato growers both in America and in Europe. Whether or not fully as good results can be obtained from home-grown seed which is protected by mulching or in some other way, and which is harvested when still immature, has not been definitely determined. At the present time it seems advisable to introduce into southern Ontario a fair proportion of seed potatoes from northern sections. In experiments conducted at Guelph over a series of years in testing potatoes obtained from New Brunswick and from Muskoka in comparison with home-grown seed, it has been ascertained that in each year the highest returns were obtained from the seed secured from Muskoka. In the past year seed potatoes obtained from north of Lake Superior gave very excellent results both at Ottawa and at Guelph.

It was the privilege of the writer, in company with Mr. Justus Miller and Mr. W. A. McCubbin, to visit in July and August of 1917 the potato-growing sections of nine districts in Northern Ontario, and with Mr. Miller and Professor Howitt to visit in the latter part of August and in early September three of the sections in Southern Ontario where potatoes are grown extensively for commercial purposes. As the results of experiments and investigations it seems quite evident that Northern Ontario has very favorable conditions for the production of seed potatoes of high quality. At the present time the potato diseases are much less troublesome in the northern as compared with the southern part of the Province. It is interesting to note that in average annual yield of potatoes per acre, 1912, 1913 and 1914 produced the highest, and 1915, 1916 and 1917 the lowest of any period of three consecutive seasons in the past thirty-five years. The last three years referred to have been abnormal seasons and have apparently furnished conditions favorable for the development of certain diseases in the potato crop.

A conference was called by the Commissioner of Agriculture, and held in the Parliament Buildings at Toronto on the 30th and 31st of October, 1917, to discuss the best methods for improving the potato industry of the Province. A committee, of which the speaker was chairman, was appointed to recommend varieties regarding the varieties of potatoes most suitable for growing for commercial purposes throughout Ontario. The Association finally adopted the following recommendation:

"That the Irish Cobbler be recommended as a standard early variety for commercial purposes and the Early Ohio as an extra-early variety for market gardeners to meet the requirements of special markets. The Green Mountain was recommended as a standard late variety, with certain other late varieties, as Carman No. 1, Dooley, Rural New Yorker No. 2, etc., recognized as standard varieties, and be recommended for those districts where conditions are peculiarly favorable to their growth. Where a variety was found especially suited to the conditions, farmers were advised to confine their attention to such variety."

The Extra Early Eureka is very similar to the Irish Cobbler, and if these two varieties were shipped in the same car for commercial purposes no serious results would follow. The same could be said in regard to the Davies' Warrior and the Green Mountain. Both the Irish Cobbler and the Green Mountain varieties are well established in Ontario, and in many localities it is believed that either one or the other of these varieties might be grown to the exclusion of other kinds. By so doing, more satisfactory results could be obtained from potato production in Ontario.

Root Crops in Ontario.

Before corn was grown extensively in this Province the root crops occupied an exceedingly important place in connection with crop production. With the gradual increase of the corn crop, especially for fodder and for silage, there has been a tendency to reduce the acreage devoted to the cultivation of field roots. From a study of the statistical reports of the Bureau of Industries for Ontario we find that with practically all classes of root crops there has been a considerable decrease in acreage. In 1900 the turnip crop reached its maximum for Ontario with 156,583 acres. By 1910 the acreage was down to 108,360 acres and in 1918 to 85,449. The mangel crop had its greatest acreage in 1903, reaching 80,918 acres in that year, and in the present season the area used for the mangel

crop was 40,714 acres. In 1895 there were 13,002 acres used for the cultivation of field carrots in Ontario, and in 1917 the acreage was 2,920.

The combined estimated market value of the root crops of Ontario, not including potatoes, amounted to $13,404,317 in 1917. These figures show that the root crops of Ontario still occupy an important place in the agriculture of the Province.

Varieties of Mangels.

The estimated market value of the mangel crop to Ontario now amounts to about two and one-half million dollars annually. In 1917 the value of this crop in Ontario was estimated at $3,898,525.

Mangels are classified as long, medium, tankard or globe, according to their shape, and each class is sented by a number of varieties. Some of these varieties vary greatly not only in shape but also in size and color. In our experimental grounds we have tested mangels under about one hundred and thirty different names. In a few cases, however, the mangels under different names resemble one another so closely that they may be considered as the same variety, and yet we frequently find differences in purity of seed, in germination, and in productiveness even of these mangels, owing no doubt to the varying conditions under which the seed has been grown, harvested, stored, transported, etc. It is very difficult indeed to get a definite knowledge of the different varieties of mangels from seedsmen's catalogues. The importance of carefully conducted experimental work is evident in order that the different varieties may be grown and studied under uniform conditions.

The real mangel seeds are about the size of the seeds of common red clover. The seed, however, is produced in the form of clusters. These clusters as bought through the seed trade may contain one seed each or they may contain even up to seven seeds per cluster. There has not as yet been any satisfactory way of breaking the clusters so as to get a suitable separation of the individual seeds. In practically all cases, therefore, it is the clusters which are sown in the case of mangels and also in the case of sugar beets.

Great emphasis has been placed on the germination of mangel seed in the experimental work conducted at the College with different varieties. The varieties have all been planted from two to three times each season. In every instance the land has been marked in both ways and exactly the same number of clusters have been planted. After germination has taken place and the young plants have reached a height of about two inches, the young plants have been carefully counted and records made. The plants have then been thinned so as to leave one plant in each place. In a few instances, however, the germination has been so poor that even with the great care taken and the large amount of seed used, it has been exceedingly difficult to secure a perfect stand. As the work has been repeated each year, however, and has been conducted from season to season, we present the average results in yield per acre and in percentage of germination as shown by the different varieties and the different strains of the varieties with a considerable amount of confidence. The following table gives the average results for the past **five years.**

Varieties.	Percentage Germination from Clusters in the Field	Weight per Root (lbs.)	Yield of Tops per Acre (tons).	Yield of Roots per Acre.	
				Tons.	Bushels.
Garton's Large Red Intermediate	104	2.67	2.66	26.85	1074.0
Yellow Leviathan (Simmers')	76	2.83	4.28	24.08	963.2
Yellow Leviathan (Rennie).....	89	3.00	4.27	24.04	961.6
Yellow Leviathan (Bruce)	97	2.81	3.84	23.60	944.0
Steele, Briggs' Giant Yellow Intermediate	87	2.89	3.96	23.48	939.2
Yellow Leviathan (Steele, Briggs').....	74	3.39	3.77	22.86	914.4
Sutton's Mammoth Long Red	82	2.52	4.14	22.67	906.8
Yellow Leviathan (Keith)	93	2.45	3.66	22.52	900.8
Carter's Sugar	73	2.55	3.75	22.49	899.6
Sutton's Prize Winner Yellow Globe	102	2.42	2.17	22.49	899.6
Carter's Dreadnought Yellow Oval Shape.	83	2.41	1.83	21.90	876.0
Yellow Leviathan (Ferry)	67	2.88	4.18	21.83	873.2
Steele, Briggs' Prize Mammoth Long Red.	95	2.43	4.32	21.57	862.8
Keith's Prize Taker.....	97	2.27	1.85	21.32	852.8
Ideal (Ontario Seed Co)	95	2.46	2.66	21.30	852.0
Rennie's Selected Mammoth Long Red...	103	2.36	4.44	21.20	848.0
Yellow Globe Selected (Steele, Briggs') .	66	2.52	1.95	20.80	832.0
Yellow Leviathan (Hewer)	51	3.35	4.12	20.31	812.4
Simmers Mammoth Prize Long Red	83	2.49	4.14	19.40	776.0
Bruce's Gate Post Mammoth Long Red..	88	2.39	4.17	18.28	731.2

It will be seen from the foregoing table that the highest half dozen lots of roots in average yield per acre were all of the intermediate class, four of them being the Yellow Leviathan, as sold by four of our Ontario seedsmen. It will be noticed that the Yellow Leviathan has varied greatly in accordance with the source of the seed. In the five years' experiments, Yellow Leviathan obtained from one seedsman came second from the top of the list, and Yellow Leviathan from another seedsman, third from the bottom of the list, in yield of roots per acre, the difference being an average annual yield of 151 bushels per acre. It is interesting to note that Simmers' Yellow Leviathan comes second highest in yield and Simmers' Mammoth Prize Long Red, second lowest, in average yield per acre. It will again be noticed that one of Bruce's mangels comes fourth from the top, and another variety of mangels, the seed of which was obtained from the same seedsman, is at the very bottom of the list.

It will be seen that in only three cases was the percentage germination from clusters in the field over one hundred per cent., and two of these were from seed which was imported directly from England. The lowest average percentage of all the mangel seed obtained for the five-year period was for the Yellow Leviathan obtained from Hewer, of Ontario, and the highest percentage was from the Garton's Large Red Intermediate obtained from Garton, of England.

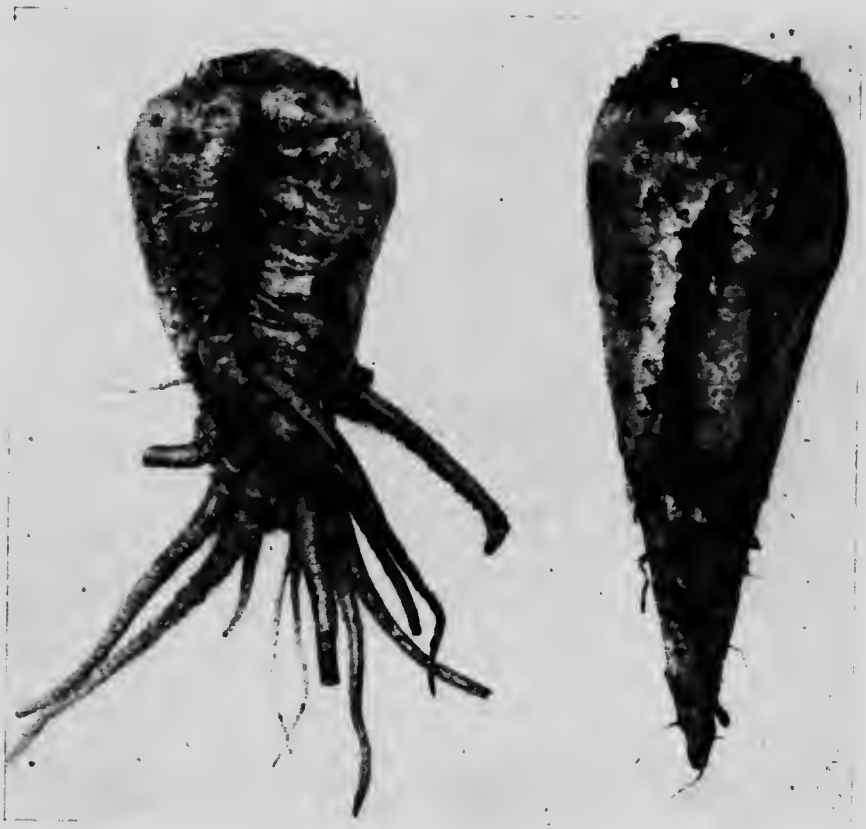
Varieties of Sugar Beets and of Sugar Mangels.

In 1901, four sugar beet factories, with an aggregate capacity for slicing two thousand two hundred tons of beets per day were built at Berlin, Waterloo County; at Wiarton, Bruce County; and at Wallaceburg and Dresden, Kent County. In 1904, the Dresden Sugar Company removed their factory to the State of Wisconsin, and the Wiarton Sugar Manufacturing Company suspended operations. In 1915 and 1916, an exceptionally fine sugar beet factory was erected at Chatham, and in 1917 and in 1918 beet sugar was manufactured by the

Dominion Sugar Company at their three factories in Kitchener, Wallaceburg and Chatham.

In the past few years the sugar beets grown in Ontario have given an average of about ten tons per acre and of sixteen and one-half per cent. of sugar. In consideration of the great scarcity of sugar throughout the world it seems reasonable to expect that a sufficient quantity of sugar beets of high quality will be grown in Ontario to supply the three factories to the limit of their capacity.

The percentage of sugar amounts to approximately five per cent. in mangels, ten per cent. in sugar mangels and fifteen per cent. in sugar beets. There are,



Kleinwanzlebener Sugar Beets.

of course, quite decided variations in the percentage of sugar, owing to varieties used and methods of cultivation practised. Mangels grow largely above the ground, sugar beets almost completely under the surface of the soil, and sugar mangels occupy an intermediate position in this respect. Mangels and sugar mangels are grown for feed production and sugar beets for the manufacture of beet sugar.

Numerous experiments have been conducted at the Ontario Agricultural College in growing mangels and sugar mangels as feed for farm stock, and in growing sugar beets to determine the quantity and the quality of the roots produced in Ontario for sugar production.

For six years in succession fourteen varieties of sugar beets and sugar mangels were carefully tested under uniform conditions in the Field Husbnadry Department at the College. The tests were made in the experimental field, which is composed principally of an average clay loam. The land received one application of farmyard manure in each rotation of four years, no commercial fertilizers being used. The roots followed grain crops, the land being ploughed in the autumn. The rows were 21 inches apart and the roots 7 inches apart in the rows. At the time of harvest, careful determinations were made of the weights of both the roots and the tops and of the number of roots of each variety. A number of average roots were collected each year and taken to the Chemical Department where they were analyzed. The following table gives the average results of the **six years'** experiments in showing the yields per acre and the quality of the roots for sugar production:

Varieties.	Average 6 Years. Analysis of Juice.		Average 5 years. Length of Roots.		Average 6 Years.		
						Yield per Acre.	
	Per Cent. Purity.	Per Cent. Sugar.	Above Ground (ins.)	Below Ground (ins.)	Weight per Root (lbs.)	Tops (tons).	Roots (tons).
1. Giant White Feeding ...	72.2	8.4	3.78	4.68	1.49	3.48	29.91
2. Royal Giant	79.7	9.9	3.50	5.27	1.36	2.95	26.97
3. Giant Rose Feeding	81.7	10.3	3.22	5.15	1.29	2.48	25.93
4. New Danish Improved..	80.3	10.8	2.66	5.59	1.27	6.66	25.20
5. Red Top.....	81.4	10.9	2.72	5.47	1.24	3.96	24.54
6. Red Skinned.....	80.8	11.7	1.83	6.22	1.18	4.45	22.94
7. Green Top White	81.0	12.6	1.08	5.77	1.15	5.72	22.61
8. White Silesian.....	83.0	13.7	1.14	6.14	1.19	5.77	22.57
9. Lane's Improved.....	82.5	12.8	1.61	5.73	1.11	5.22	21.54
10. Champion	85.0	15.6	1.31	6.77	1.05	7.79	20.69
11. Kleinwanzlebener.....	87.8	16.6	.58	6.02	1.04	8.47	20.68
12. Petzscheke's Elite	87.1	16.1	.62	5.97	1.06	6.62	19.07
13. Improved Imperial.....	88.5	17.0	.57	5.66	.99	5.98	18.42
14. French Yellow.....	82.7	12.7	1.45	6.36	.95	4.59	17.81

Of the fourteen varieties of roots included in the table here presented, the Kleinwanzlebener gave the highest average total yield of sugar per acre, when both the yield and the quality of roots were taken into consideration. This variety originated in Germany by selecting for many years only those roots which had a very high sugar content. The Kleinwanzlebener variety of sugar beets has been used more extensively for sugar production in America than any other variety. It will be seen that those varieties of beets which gave the highest percentages of sugar produced medium sized roots, which grew almost entirely underground. In comparing the different varieties it will be noticed that as the percentage of sugar decreased there was usually an increase in the yield of roots and a decrease in the yield of tops. There are, however, some marked exceptions to this rule, as the New Danish Improved gave a very large yield of tops and a comparatively low percentage of sugar, and the French Yellow variety which furnished an average amount of sugar was the lowest yielder of roots on the list.

As a farm crop, however, it will be seen that the Giant White Feeding gave practically thirty tons of roots per acre. This is a large yield and is about three

tons per acre greater than the next variety on the list. A larger percentage of the roots grew above the surface of the ground than that of any other variety reported. In this respect, and in the percentage of sugar, this variety more closely resembles the mangels than any of the other kinds here mentioned.

Six varieties of sugar beets and of sugar mangels have been grown under similar conditions in the experimental grounds in each of nineteen years. The following gives the average results for the nineteen-year period in tons of roots per acre per annum: Giant White Feeding, 25.8; New Danish Improved, 21.8; Royal Giant, 21.7; Giant Rose Feeding, 21.4; White Silesian, 20.3, and Improved Imperial, 17.1.

In each of the past five years, Ontario grown seed, from a special variety of sugar beets particularly rich in sugar content, has been obtained from the Dominion Sugar Company. This variety and the Kleinwanzlebener have been grown in the experimental plots under similar conditions for the **five-year** period. The following gives the results of this experiment in yield per acre of both tops and roots:

Varieties.	Tons of Tops per Acre.					Tons of Roots per Acre.				
	1914	1915	1916	1917	1918	1914	1915	1916	1917	1918
Kleinwanzlebener.....	6.1	13.6	1.8	5.5	8.7	15.4	18.8	3.9	14.6	18.5
Dominion Sugar Co.....	6.3	15.9	2.1	6.3	8.4	15.6	19.8	5.0	15.8	18.4

It will be seen that the new strain which is now being grown and used by the Dominion Sugar Company has produced a higher yield of roots per acre than the Kleinwanzlebener variety in four out of the five years.

As sugar beets are grown with the definite object of sugar production, the growers of the beets and the manufacturers of the sugar should work in wholesome co-operation. The sugar manufacturers furnish seed of high quality at low prices, give directions regarding cultivation and offer to buy the beets under contract. Ontario farmers desiring to grow sugar beets should, therefore, make their contracts before planting.

For fuller information regarding sugar beets the reader is referred to Bulletin No. 262, printed in March, 1918, and entitled "Sugar Beets." Copies of this bulletin can be obtained by writing to the Department of Agriculture, Parliament Buildings, Toronto, Ontario.

Varieties of Swede Turnips.

Even at the time of great scarcity of labor there were 85,449 acres of turnips grown in Ontario in 1918. This, however, was the smallest acreage used for the turnip crop in Ontario during the past thirty-seven years. The highest acreage during that period was in 1900, when there were 156,583 acres of turnips grown in the Province. In securing the information in regard to the acreage devoted to turnips in Ontario no separation has been made between the Swede turnips and the Fall or soft varieties. In 1918, twenty-three varieties of Swede turnips were grown at the College, in addition to a number of strains of home-grown seed. Of this number, sixteen varieties have been grown in each of the past **four years,** and the following table gives the average results:

Varieties.	Yield of Tops per Acre (tons).	Yield of Roots per Acre (tons).
Garton's Superlative	5.29	20.01
Garton's Invicta	5.30	19.75
Garton's Model	5.45	19.58
Ne Plus Ultra (Dupuy & Ferguson)	4.75	19.34
Perfect Model (Dupuy & Ferguson	4.01	19.20
American Purple Top (D. M. Ferry)	3.94	18.87
Steele, Briggs' Durham Swede	4.93	18.87
Simmers Ne Plus Ultra	5.37	18.68
Good Luck (Steele, Briggs)	5.42	18.86
Carter's Best of All	5.02	18.55
Improved Hall's Westbury (J. A. Bruce)	4.03	18.43
Bruce's Giant King	4.00	18.31
Sutton's Magnum Bonum	4.72	17.58
Canadian Gem (Darch & Hunter)	4.37	17.23
Simmers' Defiance	4.40	16.48
Hartley's Bronze Top	4.41	16.35

On examining the turnips for shipping quality in each of the past few years, it has been found that the Perfect Model and the Garton's Model stand particularly high, while some of the other varieties also give comparatively good results. It will be seen that the Hartley's Bronze Top, an old variety which at one time occupied an important place in turnip growing in Ontario, is now at the bottom of the list in yield of roots per acre.

The Garton's Superlative has given the highest average yield per acre, produces roots purple in color, oval in form and with comparatively short necks.

Of each of six varieties which have been under test for twelve years in succession, the greatest yields in tons of roots per acre have been produced by the Carter's Invicta, 19.0; Good Luck, 18.9; Improved Hall's Westbury, 18.2; Sutton's Magnum Bonum, 18.1; Simmers' Defiance, 17.6, and Hartley's Bronze Top, 17.1.

Varieties of Fall Turnips.

There is a limited acreage of fall turnips grown in Ontario each year. Roots of this class usually yield more per acre than the Swede turnips but they do not keep so late into the winter. Other names for fall turnips are Soft turnips or White Flesh turnips.

Two varieties of fall turnips have been grown under test at the College in each of the past seventeen years, and the following gives the average annual results in tons per acre of tops and of roots for each of the varieties: Red Top White Globe, 4.0 and 26.3, and Cow Horn, 5.8 and 19.7 In 1918, the Red Top White Globe gave 21.2 and the Cow Horn 15.5 tons of roots per acre. In comparison with these in the test of the past year the Sutton's Purple Top Mammoth gave 20.8, the Sutton's Imperial Green Globe, 18.8, and Kelway's Green Globe, 16 tons per acre.

Varieties of Field Carrots.

Although field carrots are not grown as extensively in Ontario as they were a few years ago, there is still about three thousand acres devoted to this crop annually. The area in 1917 was 2,920 acres and the estimated value of the crop $151,658. The largest amount of carrots is grown in Carleton County, where last year over one hundred thousand bushels were produced.

Five varieties of field carrots have been tested under similar conditions in each of the past nineteen years. The following table gives the average yield in tons per acre per annum for each of the five varieties for the **nineteen-year** period:

Varieties.	Color.	Length of Roots. (ins.).	Yield per Acre. (tons).
Steele Briggs' Improved Short White	White.	8.4	**26.6**
Bruce's Mammoth Intermediate Smooth White	"	8.7	**26.3**
Simmers' Improved Giant Short White	"	8.3	**25.9**
Large White Belgian	"	10.6	**23.7**
Carter's Gate Post Orange Long	Yellow	8.8	**21.9**

The Steele, Briggs' Improved Short White variety which gave the highest yield of roots per acre of five varieties for nineteen years, occupies third place in yield per acre of seven varieties grown in the past seven years, the highest yields being produced by Rennie's Mammoth Short White, 23.5 tons, and by Simmers' Improved Giant Short White, 23.1 tons. In 1918, the highest yield of carrots with seven varieties under test was 30.4 tons produced by each of Rennie's Mammoth Short White and Keith's Improved White Intermediate varieties.

Varieties of Kohl Rabi.

Kohl Rabi resembles cabbage in its development of roots, and swede turnips in the appearance of its leaves. The valuable part grows about three inches above ground in the form of a bulb. These bulbs are used as a vegetable for the table or as feed for farm stock. When grown as feed for farm stock, they may be pastured in the field by sheep or harvested and stored for winter feed somewhat similar to mangels and turnips. In England, Kohl Rabi is grown much more extensively than in Ontario.

In order to secure information as to the value of this crop in Ontario, a number of varieties of Kohl Rabi were formerly grown in our experimental grounds. After these had been carefully tested, the number of varieties was reduced to two. Each of these two varieties have now been grown under test for **seventeen years,** and the average results are as follows:

Varieties.	Weight per Root. (lbs.).	Yield per Acre.	
		Tops. (tons).	Roots. (tons).
Early White Vienna	1.5	3.1	**16.7**
Goliath Purple	1.3	7.1	**13.6**

The Early White Vienna surpassed the Goliath Purple variety in yield of roots per acre in each of fourteen out of the seventeen years. The kohl rabi is not equal in yield per acre to the leading varieties of mangels, turnips or carrots in the experiments conducted at the College. This crop, however, may have a limited place in the agriculture of Ontario, but will not likely be used by more than a few farmers in this Province.

Varieties of Parsnips.

Enquiries have been made on different occasions regarding the value of parsnips as a root crop for stock feeding in Ontario. They have been grown only to a very limited extent in this Province. Several varieties were tested at the College, but each of these has been dropped from the test with the exception of three kinds, two of which have been grown for **eighteen years** in succession with the following results:

Varieties.	Yield of Tops per Acre (tons).	Yield of Roots per Acre (tons).
Sutton's Cattle	4.0	10.8
New Ideal Hollow Crown.....	3.8	10.6

Another strain of the Hollow Crown variety, the seed of which was produced in Ontario, has been under test in each of the past six years during which time it has been given an average of 11 tons of roots per acre in comparison with 9.9 tons produced by the Sutton's Cattle during the same period. In 1918 the Ontario grown seed of the Hollow Crown variety gave 11.1 tons per acre in comparison with 10.1 tons produced by the Sutton's Cattle and 7.2 tons by the New Ideal Hollow Crown. It will be seen that the parsnips have not produced as large a yield per acre as the Kohl Rabi which, in turn, gave a lower yield per acre than the other classes of field roots grown in Ontario.

The Production of Field Root Seed in Ontario.

During the past eleven years experimental work has been conducted at the Ontario Agricultural College in the growing of mangel, turnip and carrot seed

A Crop of Mangel Seed in Shock.

with the object of gleaning information regarding seed production of these classes of roots in this Province. We have met with very good success indeed in the production of mangel seed but have not had quite as good satisfaction in the growing of turnip seed or of carrot seed.

With only two exceptions in eleven years, we have had good returns from mangel seed production at the College. Six years ago the mangel seed germinated

only 27 per cent. from the clusters. This was probably owing to the fact that we had a frost in the early part of September and the mangel seed was not harvested until the latter part of the month. Again, two years ago mangel seed production was a failure in Ontario. The seed produced at the College germinated only about 10 per cent. We had one acre of mangels for seed which looked promising, but when the plants were in bloom we had an exceptionally hot, dry spell, which seemed to seriously affect the plants. At harvest time many of the plants had a good appearance, but they contained no vital seeds. Not only was this true in our own experimental grounds at the College, but the conditions were very similar throughout the Province. This was a great disappointment, as we had been working on a special strain of the Yellow Leviathan variety, which we had carefully selected. In July, 1915, we planted seed of this special strain and produced about fifty thousand stecklings. In the spring of the following year not only did we plant about six thousand of these stecklings ourselves, but we distributed about forty thousand to some twenty-five progressive farmers throughout Ontario. Had the season been favorable, we would probably have had from six

Cutting a Crop of Mangel Seed.

to ten tons of seed of this special strain of the Yellow Leviathan mangel, which would have been of great service for the production of more stecklings in the spring of 1917. In 1917 we planted at the College a little less than an acre of stecklings of another selected strain of the Yellow Leviathan mangel. This area gave us 1,363 pounds of well-matured, thoroughly cleaned mangel seed which gave a germination of over two hundred per cent. from the mangel clusters. The most of this seed was sold in the spring of the present year at $1.50 per pound as stock seed for the production of more stecklings. We could evidently have sold our complete supply at that price, but kept a few hundred pounds for fear of shortage in 1918. If we had sold the entire amount it would have brought over two thousand dollars for the amount of seed produced on less than one acre. The seed for 1918 has not yet been weighed, but the yield will probably be about one thousand pounds per acre on an area of one and one-half acres of the Yellow Leviathan strain.

In the average results for ten years at our College, very careful field tests show that our home-grown mangel seed gave an average percentage of germination from the clusters of 119 per cent., while in the average of the same ten years,

the imported seed obtained through three of the leading seed houses gave 72, 77 and 76 per cent. We have not obtained imported seed from any source which has given us as high a percentage of germination over a series of years as we have obtained from the seed produced at Guelph.

If farmers, who have some good mangels stored in their root cellars, would next spring, when the growth of vegetation is starting, plant these on a piece of well-tilled land, they would be able to grow seed for home use. As near perfect roots as possible should be selected and these should be planted about thirty inches apart each way. We have occasionally obtained as high as a pound of seed per plant, but this is exceptional and it would not be wise to count on more than from four to eight ounces of seed per plant on the average. By transplanting from fifty to one hundred plants in the spring, a nice quantity of seed should be obtained. This would greatly help out the situation in furnishing home-grown seed and in showing what can be done in seed production in different localities throughout the whole Province. In former years our mangel seed was nearly all imported from Europe and the stocks of European seed have become practically all exhausted. It is well for us to continue our experimental work in the production of mangel seed and it is quite possible this might eventually develop into a new industry in this country.

Varieties of Corn for Silage and for Fodder.

In 1892 there were 91,403 acres of silo corn grown in Ontario. The area for this crop gradually increased until 1902, when it amounted to 209,859 acres. There was then a yearly decrease until 1906, at which time 180,796 acres were used for this crop. From 1906 to 1917, with only one slight exception, there was a yearly increase up to 511,329 acres. In 1918, however, the crop dropped to 380,946 acres. The great drop in the acreage of silage and fodder corn in the past year has undoubtedly been due to the great scarcity of both seed and labor. Those counties which produced the greatest acreage of corn for the silo in 1917 were in the following order: Oxford, 34,202; Middlesex, 29,817; Carleton, 21,746; Lambton, 21,152; Perth, 19,923; Huron, 18,975; and Ontario, 18,471 acres. Under normal conditions the acreage used for silage corn in Ontario is likely to increase substantially from year to year.

No one variety of fodder corn is suitable for all parts of the Province. Owing to the importance of the crop in Ontario, especially for the production of fodder or of silage, extensive experiments have been conducted, the results of which might form a general guide for the farmers in different sections of the Province. A large number of varieties have been planted in duplicate tests in the experimental grounds in each of a number of years past. The results are reported in such a way that they should form available information to any one interested in corn growing in the Province of Ontario whether he be located in a southern, central or northern section. From the results presented he is able to glean information in regard to the total yield per acre, yield of ears, stage of maturity, etc. In the experimental work the corn has usually been planted during the last ten days of May and it has generally been harvested about the middle of September. Immediately after the corn has been cut the weight of the whole crop has been taken, after which the ears have been harvested, counted, weighed and examined. The stage of maturity of the corn has been indicated by the condition of the grain at the time it was cut. The seven terms which have been used to describe the corn in regard to its ripeness have been as follows: Water, Early Milk, Milk, Late Milk, Dough, Firm Dough and Ripe.

It is important to test not only the distinct varieties, but also to make a study of the sources of seed of the individual varieties as much as possible. The results

presented in a general table give the record of the White Cap Yellow Dent corn obtained from several different sources in Ontario. These different lots of this variety had been selected by the individual farmers for a number of years, and it will be seen that the results of the different strains vary considerably. The following table gives the average results of duplicate tests in each of **ten years** for each of thirty-five varieties of corn:

Varieties.	Class of Corn and Color of Grain.	Average Results for Ten Years, 1909–1918.					
		Condition of Grain When Harvested.	Number of Days Until in Full Tassel.	Height of Plant (inches).	Weight per Ear (ozs.)	Yield per Acre.	
						Husked Ears (tons).	Total Green Crop (tons).
Eureka	Yellow Dent	Early Milk	99	107	6.26	2.61	18.88
Reid's Yellow Dent	"	"	97	105	5.96	2.63	17.93
Salzer's North Dakota	White Flint	Dough	86	88	5.73	3.42	17.88
Gold Nugget	Yellow Flint	Firm Dough	85	93	8.00	3.92	17.72
Compton's Early (U.S.)	"	"	87	94	7.09	3.61	17.54
Longfellow (U.S.)	"	"	88	91	5.45	2.93	17.50
Mammoth Southern Sweet	White Dent	Early Milk	98	99	5.60	2.38	16.97
Simmers' Mammoth Eight-rowed	Yellow Flint	Firm Dough	85	87	5.39	3.01	18.41
Genesee Valley	"	"	84	86	5.83	3.11	16.40
Stowell's Evergreen	Sweet	Milk	93	87	6.23	2.94	16.21
Compton's Early (Ontario)	Yellow Flint	Firm Dough	86	90	7.32	3.54	16.16
Improved Leaming (Vick)	Yellow Dent	Milk	92	101	7.46	3.31	16.14
Rennie's XXX. Early Sweet	Sweet	Late Milk	88	79	7.01	3.89	18.07
White Cap Yellow Dent (H. Smith)	Yellow Dent	"	90	99	8.55	3.51	15.94
Duke's Improved Sweet	Sweet	Milk	94	87	6.38	2.94	15.69
Wisconsin No. 7	White Dent	Late Milk	88	94	7.57	3.46	15.63
Sanford	White Flint	Firm Dough	85	89	6.59	3.22	15.49
Early Butler	Yellow Dent	Milk	88	98	7.23	3.45	15.37
Longfellow (Ontario)	Yellow Flint	Firm Dough	83	88	6.18	3.20	15.32
King Phillip (Ontario)	Colored Flint	"	83	89	6.15	3.12	15.32
White Cap Yellow Dent (E. M. Zavitz)	Yellow Dent	Dough	84	96	8.13	3.68	15.03
Australian Extra Early Eight-rowed White	White Flint	Firm Dough	83	86	6.92	3.63	14.71
Golden Glow or Wisconsin No. 12	Yellow Dent	Late Milk	84	92	7.92	3.82	14.55
Leaming (Ontario)	"	Milk	91	99	7.96	3.08	14.55
White Cap Yellow Dent (Dawson)	"	Late Milk	87	96	7.46	3.22	14.47
Red Blazed	Colored Flint	Firm Dough	82	87	6.51	3.04	13.96
Improved Early White Cap (J. O. Duke)	Yellow Dent	Dough	84	99	7.14	3.1[illegible]	[illegible]
Sterling White Dent	White Dent	Dough	86	90	7.36	2	
University No. 13	Yellow Dent	Firm Dough	83	90	7.42		
Early California Flint	Yellow Flint	Ripe	82	83	7.32		
White Cap Yellow Dent (Hammond)	Yellow Dent	Dough	82	89	7.24		
Early Colorado Dent	"	Ripe	76	83	7.01	3	
Pearce's Early Evergreen	Sweet	Late Milk	78	73	6.91		11.7[illegible]
Mammoth White Cory	Sweet	Dough	76	64	5.53		11.50
Golden Bantam	Sweet	"	77	58	3.75	.63	8.80

There is a general impression that dent corn yields more than flint corn. This is true only to a very limited extent. It will be seen that the Salzer's North Dakota White flint corn occupies third highest place and the Early Colorado yellow dent corn the fourth lowest place in average yield of green crop per acre per annum. It will be observed that as a general rule the late corns are heavy and the early corns are light yielders. There are, however, quite decided exceptions to this rule and it is the exceptions which are brought out by the results of the experiments, and which form the important part in the tests. The Salzer's North Dakota, for instance, with almost 18 tons of green crop per acre was in the dough stage, while under similar conditions the Improved Leaming gave about 16 tons per acre and only reached the milk stage. From general appearances of the growing crop a person is apt to be deceived, as the dent varieties, with single stalks, have a showy appearance, while the flint varieties, with shorter stalks and more leaves and suckers, generally yield higher than the appearance when growing would seem to indicate. Not many people realize, for instance, from the appearance of the growing corn, that the Salzer's North Dakota or the Compton's Early would likely produce, throughout the central part of Ontario, heavier crops of green material per acre than the White Cap Yellow Dent or the Wisconsin No. 7 varieties. The results here presented are worthy of careful study, as they represent the average of twenty separate tests of the thirty-five varieties included in the experiment.

It will be seen that the White Cap Yellow Dent varied from 15.9 tons to 12.7 tons in total yield of green crop per acre and that the stage of maturity varied from the late milk to the dough. It will also be seen that the Compton's Early produced 17.5 tons per acre from seed obtained in the United States and 16.2 tons per acre from seed which was secured in Ontario. In yield of ripened grain, however, the Ontario seed considerably surpassed the seed obtained from the United States in the case of both the Compton's Early and the Longfellow varieties. The Gold Nugget corn, although possessing ears which are not particularly attractive, is a variety of considerable promise, as it is a comparatively early variety, giving large yields of both ears and total crop. In growing corn for the silo it is important not only to have a knowledge of the different varieties but also to secure as much information as possible regarding the source of the seed.

Varieties of Sorghum for Fodder.

Under the term "Sorghum" is included a number of different classes of crops, such as sugar cane, broom corn, kaffir corn, milo maize, etc. Those varieties of sorghum spoken of as sugar cane in seedsmen's catalogues, but which are more correctly named sugar sorghum, are used for fodder purposes in Ontario more than any of the other classes of sorghums. These sugar sorghums are sometimes used for the production of sorghum molasses.

The best results from sorghums may be expected from rich sandy loam soils. As a rule the sorghums thrive well in comparatively dry seasons. The sorghums are usually sown in rows from two to three feet apart and cultivated in much the same way as corn.

Experiments have been conducted at Guelph in testing out different varieties of sorghums, not only for seed production but also from the standpoint of the production of green fodder. For the production of fodder, the crop is usually sown the latter part of May or very early in June. In 1918, eighteen varieties

of sorghum were under experiment at the College for fodder production. The highest yields were produced by the Albaugh sugar cane, the Early Amber sugar cane, the Orange sugar cane, the Early Minnesota sugar cane, the White kaffir corn, and the California broom corn.

Seven varieties have been grown under similar conditions in each of nineteen years. Previous to 1912 the seed was planted in squares twenty-seven inches apart each way and three plants were allowed to remain in each place. The seed was planted to a depth of about three-quarters of an inch. In 1912 a change was made in the method of planting, the seed being placed in rows twenty-six inches apart and ten inches apart in the rows. One plant was allowed to remain in each place. In each year the sorghums received cultivation throughout as required. The experiment was conducted in duplicate in each season. The following table gives the average results of each of seven varieties for the past **nineteen years:**

Varieties.	Height. (ins.).	Yield per Acre.	
		Heads. (tons).	Total Crop. (tons.)
Early Minnesota Sugar Cane	103	.79	16.96
Orange Sugar Cane.....	89	.34	16.73
Early Amber Sugar Cane	94	.90	14.93
White Kaffir Corn	64	.54	11.46
Early Japanese Broom Corn.....	100	1.30	10.49
California Broom Corn	107	1.42	10.46
Improved Evergreen Broom Corn ..	103	1.30	9.50

The results here presented show that some of the sorghums can be grown in Ontario with a considerable amount of satisfaction, as three varieties have given practically fifteen or more tons of green crop per acre per annum for the past nineteen years. Although the Orange Sugar Cane gave the second highest yield per acre, it is not as early as either the Early Minnesota or the Early Amber. The Early Amber variety is the one which is grown more than all other varieties combined in Ontario. It will be seen that this variety has given a higher yield of green crop per acre than many of the varieties of corn. Sorghum is grown both for fodder and for seed production in some parts of Ontario, especially in the south-western portion. In normal years sorghum seed is frequently used in a mixture of oats, sorghum and clover as an annual pasture crop by using 51 pounds of oats, 30 pounds of sorghum and 7 pounds of Common Red Clover seed per acre. This mixture has given very good satisfaction, but, during the last three or four abnormally wet seasons, the sorghum has not been used as extensively, owing to the scarcity and the high price of the seed.

In each of several years important work has been under way in plant selection with the Early Amber variety of sorghum. When seed is taken from individual plants selected in a field of sorghum and these are tested out individually, quite decided differences are observed. By following this up over a series of years and by combining some of the most promising strains, it is hoped before long that an improved strain of the Early Amber sugar cane may be secured. The results so far are quite promising.

Varieties of Millet for the Production of Fodder.

In some seasons, millet is grown quite extensively and in other years to a very limited extent. It is looked upon largely as a supplementary crop and its cultivation depends mainly upon the success or the failure of other fodder crops. It can be sown comparatively late in the season on land on which corn or some of the other crops can not be planted at the proper time. It can also be sown at a season of the year after which time it is known whether or not the ordinary hay crop of the country will likely prove to be above or below the normal. Besides using millets as a supplementary crop, some people grow a small acreage regularly as an annual crop for the production of hay or of green fodder. As a rule, about twenty-five pounds of seed are used per acre on land which has been carefully cultivated and is in a moist condition to insure quick germination. If seeding takes place in May or about the first of June, a late variety may be sown, but, if the seeding does not take place until the latter part of June or in July, an early variety is likely to give the best satisfaction.

Sixteen varieties and strains of millet have been grown for fodder in each of **Five Years,** the average results for that period being as follows:

Varieties.	Height. (ins.).	Yield of Green Fodder. per Acre. (tons).	Yield of Hay per Acre. (tons).
Japanese Panicle	38	11.5	4.32
Siberian No. 92	31	9.6	3.85
Siberian No. 91	31	9.7	3.78
Japanese Panicle No. 91	40	9.9	3.71
Siberian No. 71	31	9.3	3.66
Steele Trust	31	8.9	3.65
Holy Terror Gold Mine	32	8.8	3.57
Siberian	30	9.1	3.54
Japanese Barnyard	40	9.0	3.52
Golden Wonder	29	8.4	3.50
Japanese Barnyard No. 91	40	9.2	3.49
Kursk	28	8.3	3.41
Hungarian Grass	31	7.9	3.31
German or Golden	32	7.4	3.05
Common	33	7.5	2.98
Japanese Barnyard (Minami)	35	8.0	2.95

The Japanese Panicle variety occupies highest place on the list in the production of both green fodder and hay. This variety has been grown in a test of seven varieties for a period of twenty-two years and also heads the list with an average of 10.6 tons of green crop per acre. The Japanese Panicle variety of millet was brought from Japan by Professor Brooks, of the Agricultural College, Amherst, Massachusetts. Professor Brooks occupied a position on the staff of an agricultural college in Japan for seven years previous to his return to the United States. He brought with him three varieties of millet, representing three types, viz.: Japanese Panicle, Japanese Barnyard and Japanese Common. The Japanese Panicle millet produces plants of an upright growth, a spreading head and a large leaf development. The crop usually stands up well and is highly productive. The seed of the Japanese Panicle millet is smooth, shiny and of a dark brownish color. In ordering seed of the Japanese Panicle millet from the seedsmen, great care should be taken to make the order very distinct, or it is quite probable the Japanese

Barnyard will be forwarded instead of the Japanese Panicle. In some of the seedsmen's catalogues, the mistake of describing the Japanese Barnyard and illustrating the Japanese Panicle has been made, when both of these have referred to the same millet. It is always wise to secure a sample of millet and then order according to sample if the seed is true to name. The Japanese Panicle and the Japanese Barnyard millets not only represent different varieties, but they actually represent different species.

Sowing Millets at Different Dates.

The Japanese Panicle and the Japanese Barnyard millets and the Hungarian Grass were sown on May 15th, June 1st, June 15th, July 1st, July 15th and August 1st, in each of six years. The average results for the six-year period show that the highest yields in tons of green crop per acre were obtained in the case of each of the three varieties from the seedings on June 1st. It might be mentioned, however, that for earlier seedings the Japanese Panicle and the Japanese Barnyard varieties are usually the most suitable, but for late seeding the Hungarian Grass, which requires a shorter season for growth, is frequently the most suitable variety to use.

Varieties of Rape, Kale, Cow Cabbage, Etc.

The rape plant resembles the Swede turnip in its leaf and the cabbage in its root. It is the leaf and the stem which furnish the valuable portion for feeding to live stock. Rape makes an excellent late summer and autumn crop for feeding cattle, sheep and lambs, for which purpose it has been used at the College extensively in past years. Lambs have always done exceptionally well when pastured on rape. Their health has been good and their increase in live weight has been rapid. Dairy animals do well when feeding on rape, but the crop taints the milk about the same as turnips.

In 1917, there were 37,732 acres of rape grown in Ontario. In 1916, the number of acres was 38,566 and in 1915, 40,613. The reduction in the acreage during the past three years has probably been due to the great scarcity of labor in growing this cultivated crop.

We have conducted a very interesting experiment at the College in which other crops than rape have been tested. This experiment has included kale, cow cabbage, sprouting Boroccoli and rape and furnishes some good information in the comparative results of these crops when grown in Ontario under similar conditions. In 1918, eleven varieties belonging to the rape class were under experiment. The crops were all sown in rows three and one-third links (26 2-5 inches) apart. Each plot was exactly 1-100th of an acre in size, consisting of three rows each four rods in length. The experiment was conducted in duplicate. The land between the rows was cultivated occasionally throughout the growing season. When the crops had reached their best condition for feeding each variety was cut with a scythe and weighed immediately. This description applies equally well to each of the years in which we have conducted this experiment. In England, where the cabbages are grown more extensively, they are frequently transplanted and a sufficient distance is allowed between the plants to enable the heads to be formed. In our experiments at Guelph, however, we have treated the different kinds of cow cabbage in exactly the same way as we have treated rape. The heads of the cabbage have been quite small, the growth being largely

leaf and stem. The following table gives the average results in tons of green crop per acre in 1918 and for the average of **Nineteen Years:**

Varieties.	1918.	Average 19 Years.
Sutton's Earliest Drumhead Cabbage.	17.30	23.26
Thousand Headed Kale.....	13.37	19.82
Purple Sprouting Boroccoli	11.98	19.07
Dwarf Essex Rape.....	11.60	18.14

This shows the very high yielding properties of the Sutton's Earliest Drumhead cabbage.

Sutton's Earliest Drumhead Cabbage Grown for Stock Feed.

The following table gives the average results in height of crop and in yield of green crop per acre of each of eleven varieties for the past **Three Years:**

Varieties.	Height of Crop (inches).	Average Yield of Green Crop per Acre (tons.)
Sutton's Earliest Drumhead Cabbage.....	16	20.41
Carter's Monster Drumhead Cabbage	15	18.91
World Beater Cabbage	15	18.25
Swedish Giant Cabbage.....	15	17.98
Simmer's Matchless Flat Dutch Cabbage...	14	16.58
Thousand Headed Kale	25	14.15
Sutton's Purple Sprouting Boroccoli.....	23	13.44
Silver Beet.....	16	13.07
Dwarf Essex Rape	20	12.64
White Silver Swiss Chard	16	12.09
Spinach Beet	13	11.59

The Dwarf Essex variety of rape occupies ninth place in yield of green crop per acre in the average of the past three years. It was surpassed by the Sutton's Earliest Drumhead cabbage in yield per acre by over fifty per cent. It will be seen that each variety of cabbage under experiment gave a higher average yield per acre than any other crop under test. The three varieties of swiss chard under the names of Silver Beet, White Silver swiss chard and Spinach Beet give a comparatively low yield per acre in comparison with the cabbage but are about the same as the Dwarf Essex rape. It is noticed that when the swiss chard is harvested the crop quickly gives a second growth and in this respect is superior to any of the other classes of crop here reported in the foregoing table.

Thickness of Seeding Sutton's Earliest Drumhead Cabbage.

As the Sutton's Earliest Drumhead cabbage gave the highest yields per acre of all the different varieties of cabbage, rape, kale and similar crops under experiment when sown the same as rape, it was decided to conduct another experiment in using the cabbage at different thicknesses, having the plants at different distances apart in the rows. Consequently, an experiment was started in 1911 and has now been conducted in each of the past eight years in which the plants of the Sutton's Earliest Drumhead cabbage were allowed to remain at the following distances apart in the rows: one inch, two inches, three inches, eight inches, sixteen inches and twenty-four inches.

The following table gives the average results of this experiment in percentage of head and in yield of green crop per acre in the average of the **Eight Years** for each of the six thinnings:

Distance between Plants in the Rows.	Amount of Crop in form of Heads. (per cent.).	Yield of Green Crop per Acre. (tons).
1 inch	2	22.2
2 inches	4	21.3
3 "	7	22.4
8 "	15	21.5
16 "	27	20.3
24 "	32	17.1

It will be seen from the foregoing table that the greatest yield was produced when the plants were three inches apart in the rows and that the yield was fully two tons per acre more than when the plants were 16 inches and over five tons per acre more than when they were 24 inches apart in the rows. When thinned to an average of 3 inches apart, the plants were largely leaf and stem with only seven per cent. of the crop in the form of small fairly compact heads.

Miscellaneous Leguminous Crops for Green Fodder.

In 1918, twenty-one varieties of miscellaneous leguminous crops were grown in the Experimental Department with the object of securing information in regard to the production of green fodder. These included varieties of Soy beans and Cow peas. They were all planted in rows about 26 inches apart. The following gives the average height and the average yield of green crop per acre of fifteen varieties grown under similar conditions for a period of **Five Years:**

Varieties.	Height. (ins.).	Yield of Green Fodder per Acre. (tons).
O. A. C. No. 111 Soy Beans	27	7.76
Ito San Soy Beans	26	7.76
Habara Soy Beans (No. 20405 Wash.)	25	7.15
Quebec No. 537 Soy Beans	24	6.96
Medium Green Soy Beans	29	6.24
Early Yellow Soy Beans	24	5.98
O. A. C. No. 81 Soy Beans	22	5.94
Tsurunoko Soy Beans	25	5.69
Chernie Soy Beans (No. 18227 Wash.)	23	5.66
Brown Soy Beans	25	5.47
Buckshot Soy Beans (No. 17251 Wash.)	23	5.12
Quebec No. 92 Soy Beans	21	5.08
Wonderful Cow Peas	14	4.23
Whip-poor-will Cow Peas	13	3.22
Bruce's Early Soja Beans	27	2.79

The variety of soy beans which comes at the top of the list in yield of green fodder is one of our own selection. This was originated in connection with our plant breeding work with nursery plots. The two varieties of cow peas come comparatively low in the list.

The Early Yellow variety of soy beans has been under test at the College continuously since 1901. In the average of 17 years, it has given 6.4 tons of green fodder per acre per annum.

Sunflowers for Fodder.

Dr. J. W. Robertson, when Dairy Commissioner for the Dominion, strongly recommended the growing of sunflowers and Horse beans to mix with corn for silage. The production of Horse beans throughout Ontario is usually a failure, and the growing of sunflowers for use in the silo has never been practised to any great extent. In some instances, the sunflowers have been grown and the heads have been run through the cutting box along with corn when filling the silo.

Seven different varieties of sunflowers were tested in an experimental way at the College some years ago but all were dropped with the exception of three kinds which are still under experiment. Each of these three varieties have now been under test for **Nineteen Years,** with the following average results per annum:

Varieties.	16 Years.	19 Years.	
	Diameter of Heads (Ins.)	Yield per Acre.	
		Heads (tons).	Whole Crop. (tons).
Black Giant	7.2	6.4	22.0
Mammoth Russian	7.1	5.6	17.5
White Beauty	7.3	5.4	16.5

These results give the comparative amounts of head and of stalk. The stems become very woody in the autumn. It is understood that a few people use the whole crop for cutting and placing in the silo but, as the stems contain such a large amount of woody fibre, it scarcely seems reasonable that these, although kept in a somewhat succulent condition when mixed with corn in the silo, will furnish much feed of real service. There is, however, still room for investigational work regarding the value of sunflowers for mixing with corn in the silo.

Sunflowers are planted in about the same way as corn, and prove to be a hardy crop with little likelihood of a failure. In the last twenty-one years, we have never met with a failure in securing a crop of sunflowers.

Pasture Crops in Ontario.

A bulletin on "Hay and Pasture Crops—Grasses, Clovers, Etc." is almost completed and ready for the press. Information will be furnished in this bulletin regarding annual, temporary, and permanent pastures. As this important phase of Ontario's agriculture is discussed pretty fully in the bulletin, it is not necessary to present any details at this time. (See Bull. No. 269.)

Varieties of Alfalfa.

Alfalfas have obtained their varietal names from the countries in which they have been grown for a length of time, from the men who have been instrumental in their introduction or in their improvement, from the color of the flowers, etc. There are many of these so-called varieties of alfalfa. While some of these different kinds do not vary one from the other to any great extent from a botanical standpoint, there are some marked variations in character of growth, in hardiness and in productiveness. Information along these lines is of great importance in connection with alfalfa production in Ontario.

An experiment was started at the College in the spring of 1909 in which a number of varieties of alfalfa were sown on 71 plots at the rate of twenty pounds of seed per acre, with barley as a nurse crop. This experiment included some of the most noted varieties of alfalfa which were grown in Canada and in the United States, as well as others which were not so well known, except in an experimental way. As there were ten lots of Sand lucerne and nine lots of other variegated alfalfas from Europe, four lots of Common alfalfa from the central-western States, three lots of Grimm alfalfa from Minnesota and Nebraska, and two lots each of the Variegated alfalfa from Ontario and of Turkestan alfalfa from Asia, the results from these different lots of the separate varieties were averaged. These averages, as well as the results of other varieties taken separately, are presented for each of the past **Nine Years.** It is important to note that in the autumn of the first season of this experiment there was from 85 to 95 per cent. of a perfect stand of plants on each plot. The results have been affected principally by the comparative hardiness of the different varieties, and from this standpoint they are particularly interesting. The winter of 1917-18 was exceptionally severe on the old alfalfa plants, killing an unusually large number.

Varieties.	Color of Flowers.	No. of Tests.	Source of Seed.	Average Annual Yield of Hay per Acre (tons).									
				1910	1911	1912	1913	1914	1915	1916	1917	1918	Aver. 9 yrs.
Grimm	Variegated.	3	Minnesota... Nebraska ...	3.21	2.42	4.73	4.13	3.65	5.19	4.79	3.56	1.69	3.71
Ontario Variegated	Variegated.	2	Ontario	3.50	2.12	4.50	3.58	3.34	5.20	4.56	3.44	.48	3.41
Baltic	Variegated.	1	South Dakota.	3.10	2.52	4.08	3.36	3.52	5.36	4.00	3.24	.12	3.37
European Variegated	Variegated.	9	Europe	4.04	2.38	4.91	4.18	2.74	4.96	3.80	2.85	.40	3.36
Turkestan	Violet	2	Asia	3.33	1.74	4.44	3.70	2.98	5.08	3.70	3.18	.48	3.18
Sand	Variegated.	10	Europe	3.04	2.28	4.45	3.61	2.64	4.77	3.85	2.87	.35	3.10
Mongolian	Violet	1	Asia	3.20	2.12	4.92	2.72	2.36	4.84	2.80	2.64	1.84	3.05
Common	Violet	1	Ontario	3.20	.80	2.52	1.84	1.80	3.60	1.92	2.00	.04	1.97
		1	Montana (Chinook)	2.35	.96	1.64	1.48	1.88	3.52	2.48	2.16	.13	1.84
		4	Utah. Colorado Nebraska Kansas	2.31	.71	.95	.99	1.53	2.61	.85	1.11	.02	1.23
		1	Texas	2.05	.52	.76	.88	1.64	2.76	.53	.88	....	1.11
Peruvian	Violet	1	South America	2.60	.04	.72	.08	.09	.32	.05	....	....	.43
Arabian	Violet	1	Asia	.90	.02	....	....	....	....	....	....	....	.10

Even in the cropping of alfalfa from year to year from the one seeding, the yields vary greatly. These differences are largely due to weather conditions. It will be noticed that practically all varieties produced larger yields of hay in 1912 than in 1911, and in 1915 than in the year previous. These crops were all produced from the one seeding which took place in the spring of 1909.

It will be seen that of these ten varieties of alfalfa five have variegated and five violet flowers. With only one slight exception, the variegated surpassed the violet-flowered varieties in average yield of hay per acre for the nine-year period. This points to hardiness of the variegated varieties and especially of the Grimm and the Ontario Variegated.

Growing Alfalfa in Ontario.

The number of acres of alfalfa in Ontario was 177,565 in 1916, 189,109 in 1917 and 144,010 in 1918. It will be seen that there was an increase in the acreage from 1916 to 1917 but a drop during the past year. This was undoubtedly due to the exceptionally severe winter which killed many fields of alfalfa in Ontario.

This crop is being recognized more and more as a most valuable farm crop for this Province. Its perennial character of growth, its power of making use of the free nitrogen of the atmosphere and of the fertilizing elements of the subsoil, and its capacity of producing large yields of exceptionally nutritious feed for farm stock, combine to place this crop as one of the most important which can be grown. It possesses a combination of characteristics which is not found in any other farm crop. Alfalfa starts its growth early in the spring and continues throughout the summer and even late into the autumn. Under favorable conditions it produces two or three crops per annum and thrives for several years without the necessity of re-seeding. The feed is relished by practically all kinds of farm stock. It can be fed in the green or in the dry condition, or can be converted into silage. In at least some localities over Ontario the second crop in the season

is allowed to ripen for seed production to good advantage. Alfalfa is particularly suitable for use in a long rotation, and leaves the soil in an excellent condition for the growing of other farm crops. In order, however, to make alfalfa growing successful, it is important to sow the right kind of seed on suitable soil and to employ the best methods of culture.

Select land having a clean, mellow, fertile surface soil overlying a deeply drained, sweet subsoil. Use large plump seed of strong germinating power and of some hardy variety such as Grimm, Ontario Variegated or Baltic. The common alfalfa seed of the Western States, even though it has been northern grown, usually produces plants which are too tender to resist the climatic conditions of Ontario. Make use of seed which grades high according to the Seed Control Act. Inoculate the seed with the proper kind of bacteria, providing alfalfa has not been grown successfully on the land in recent years. Sow the alfalfa seed at the rate of about twenty pounds per acre. The seeding may be performed according to any one of the following methods:

1. Alfalfa seed may be sown on winter wheat in the early spring either on the old snow or on a fresh snow of one or two inches, and no harrowing or cultivation is necessary.

2 On a suitable seed bed and as soon as the land is sufficiently dry in the spring, alfalfa seed may be sown from the grass seed box placed in front of the tube drill. About one bushel of barley, wheat or rye per acre sown from the tubes of the drill makes a very good nurse crop. After the seed is sown the land should be harrowed lightly.

3. Alfalfa may be sown alone in the month of July on a summer fallow, providing there is sufficient moisture for good germination.

Alfalfa should never be pastured during the first year and seldom, if ever, afterwards, as pasturing very frequently destroys the plants. The crop should be cut for hay or for green fodder in the following year after the seeding takes place and as soon as the plants start to bloom. Care should be taken to retain as many of the leaves on the stems as possible and to protect the crop from rain. In many places in Ontario the alfalfa will produce three crops of hay per annum. The third cutting, however, may be used to advantage for mixing with corn when filling the silo as this forms an easy method of handling the green alfalfa in the autumn and also of improving the quality of the corn silage. In some localities hay may be obtained from the first crop and seed from the second crop in each season and for a period of several years.

If the directions here given are carefully followed, alfalfa may be expected to produce large and valuable crops for a number of years without re-seeding.

Alfalfa Seed Production.

Previous to the last four years of abnormally wet seasons, alfalfa seed production was becoming quite an industry in some parts of Ontario. As both a crop of hay and a crop of seed can be produced in the same season, if weather conditions are favorable, many of the alfalfa growers have found seed production quite profitable. From extensive enquiries made from farmers who had grown alfalfa seed in Ontario for at least five years, some very valuable information was obtained. We learned that alfalfa seed had been produced with success in at least thirteen counties in Ontario. In all cases where seed was produced it was taken from the second crop, the first crop of the season being converted into hay. The yield of alfalfa seed per acre varied considerably, the highest being seven bushels, and the average a little over two bushels per acre. The farmers deter-

mined the time for cutting the crop for seed production by the color of the pods, most of them stating that the crop should be cut when the pods were brown, although some of them left the crop until the pods were almost black. The majority of the farmers cut their seed crop with a mowing machine and a number mentioned having a table attachment to the machine. About twenty per cent. used the reaper and about twelve per cent. used the self-binder. As a rule the crop was cured in the windrow by those who used the mowing machine, and in the bunches by those who used the reaper, or the mowing machine with the table attachment. Those who used the self-binder cured the crop in shocks. The threshing was done mostly with a clover huller, and took place almost any time after the crop was harvested until midwinter. When the threshing is done in the autumn it is preferable to have dry weather, and when in the winter to have cold weather, in order to get the best results. Nearly all farmers reported obtaining good quality of seed in most years. The seed was sold chiefly to neighboring farmers and to local dealers. The greatest difficulties reported in alfalfa seed production in Ontario have been due to injuries caused by grasshoppers, wet weather, blighted plants, early frosts, and a few mentioned partial failures from thick seeding. The ideal condition appears to be a comparatively moist season for the production of the hay crop and a rather dry season after the hay has been removed from the land. The great majority of farmers stated that they considered seed production did not injure the plants. Nearly all were enthusiastic alfalfa growers from the standpoint of both hay and seed production.

Sweet Clover Experiments.

Sweet clover is a biennial leguminous plant, having an erect branching stemmy growth. The plant has a strong fragrant odor and a bitter taste. The growth is rather slow at first and not very large in the first year. In the second year, however, the growth is rapid and abundant. The stems become woody, the leaves easily drop from the plants on drying, and the seed matures unevenly and readily shatters on ripening, but generally yields well per acre. The seeds are formed singly on pods and closely resemble in shape, color and size those of alfalfa. The plants of sweet clover die after they produce seed at the end of from fifteen to eighteen months from the time the seed is sown.

Sweet clover thrives on a variety of soils, but seems to require an abundance of lime. It grows readily on roadsides and waste places, where the seeds reach the ground annually or biennially. Its eradication is rather difficult in uncultivated land, but not very difficult in cultivated fields. In past years seed has been harvested for market from the wild crops growing in waste places, and even at the present time seed offered for sale frequently contains many impurities. It is quite probable the seed obtainable will improve from year to year.

In an experimental way at the Ontario Agricultural College at different times within the past quarter of a century, the crop was grown for hay production in comparison with Common Red and other varieties of clover in the years 1892, 1895, 1897 and 1899. Sweet clover was compared with eight varieties of clover, sainfoin, and alfalfa from the standpoint of pasture production in the years 1902 and 1904. Various tests were made also in cutting the sweet clover at different stages of growth for feeding to different classes of farm animals, but in all instances the animals refused to eat the crop although, in some instances, it was cut when quite young and tender. The bitter flavor of the crop seemed distasteful to the animals and apparently they were not starved long enough to force them to develop the desired taste.

If sweet clover is to be used for hay production, it should be cut comparatively early, before any blooms appear. At this stage of development, the growth is not as abundant, but the plants are less woody and leaves are more easily saved than when the crop is cut at a later period. There seems to be rather more difficulty in curing hay from sweet clover than from red clover or from alfalfa.

In the spring of 1916, fifteen lots of sweet clover were sown in duplicate plots in our experimental grounds, making thirty plots in all. For this experiment, the white sweet clover seed was obtained from nine and the yellow sweet clover seed from six different sources. In 1917 the plots of each of one set were divided and the crop was cut at two different stages of maturity, allowing a few days to intervene between the two cuttings. The cuttings of each set gave some interesting results. The white varieties varied from 2.0 to 3.8 tons of hay and the yellow varieties from 1.1 to 2.3 tons of hay per acre. The average of the three cuttings of all of the varieties of sweet clover from the various sources gave the following yields of green fodder and of hay per acre in 1917:

Species of Type.	Average Yield per Acre.	
	Green Fodder (tons).	Hay (tons).
White Flowering Biennial Sweet Clover ..	10.42	2.55
Yellow Flowering Biennial Sweet Clover..	6.96	1.55

There were two lots of the biennial yellow-flowered sweet clover known under the name of "albotrea." The seed from one source gave an average of 1.28, and the seed from the other source, 1.31 tons of hay per acre. Of the six varieties of yellow biennial sweet clover under test, two gave higher and two gave lower yields than those obtained from the albotrea.

In each of two years the experiment was conducted at the College, comparing the amount of pasture crop produced by sweet clover, by alsike clover and by common red clover. The yields per acre were determined at each of six cuttings in each of the two years. Three weeks were allowed between each two cuttings. The results are very interesting in furnishing definite information regarding these three crops in the production of green clover which would correspond pretty closely to the relative amounts of pasture produced. The following table gives the average of the two years' experiments in tons per acre of pasture crop:

Periods of Cutting.	Variety of Clover, Tons of Pasture Crop per Acre.		
	Common Red.	Alsike.	Sweet.
First Cutting.....	13.5	11.0	11.0
Second "	1.4	.2	1.5
Third "	2.9	4.0	2.5
Fourth "	4.6	1.7	3.0
Fifth "	2.0	3.4	1.9
Sixth "	1.6	1.1	.9

Sweet clover is now being studied for pasture purposes, both alone and in combination with other crops.

As the plants of sweet clover vary so much in habits of growth, etc., a large amount of experimental work is being conducted at the College in securing seed from individual plants of different characteristics of growth. It is hoped that in the near future decided improvements will be obtained on the sweet clover which grows wild in waste places in different parts of the country, and that we may be able to secure a strain which retains the good features and has fewer of the objectionable characteristics of the average wild plants.

Summary Regarding Good Seed.

For the highest returns in crop production it is essential to have 1, good seed; 2, thorough cultivation; 3, fertile soil; 4, well-drained land, and 5, proper rotation of crops.

Good seed means not only large, plump, sound, well-matured seed of strong vitality and free from impurities, but also the *very best varieties* obtainable.

In order to know the best kinds, about 2,500 varieties of farm crops have been grown under test at the Ontario Agricultural College within the past twenty-

Agricultural Society Judges at practice work before starting out to judge Standing Field Crops throughout Ontario.

five years. Practically all varieties have been grown for five years in succession, after which the poorer kinds have been dropped, the better sorts have been continued, and new and promising kinds have been added to the test from time to time. Those varieties which have given the highest returns in the tests at the College have proven valuable, not only in themselves, but also as foundation stock from which to secure improved strains by selection, or new varieties by hybridization.

A few of the leading varieties obtained by introduction, by selection and by hybridization have been tested on thousands of farms throughout Ontario in the co-operative experiments conducted through the medium of the Experimental Union.

As the result of these lines of activity the following varieties have proven to be of special value for the farms of Ontario:

Oats.

O.A.C. No. 72.—Late, vigorous grower, good straw, spreading head, white grain with pinkish coloration, comparatively thin hull, high yielder of grain.

Banner.—Late, good straw, spreading head, white grain, medium hull, medium yielder.

O.A.C. No. 3.—Very early, good straw, spreading head, white grain, exceptionally thin in the hull, good yielder.

Barley.

O.A.C. No. 21.—Early, stiff straw, six-rowed head, grain bluish under the hull, good quality, heavy yielder.

Spring Wheat.

Marquis.—Early, good straw, beardless head, white chaff, red grain, excellent quality for bread production, good yielder.

Wild Goose.—Fairly early, tall straw of medium strength, compact bearded head, hard grain, particularly suitable for the manufacture of macaroni, high yielder.

Winter Wheat.

Dawson's Golden Chaff.—Stiff straw, beardless head, red chaff, white grain, medium quality, high yielder; the most popular variety of winter wheat in Ontario for many years.

Imperial Amber.—Tall straw of medium strength, bearded head, red chaff, red grain, good milling wheat, high yielder.

O.A.C. No. 104.—Stiff straw, beardless head, white chaff, white grain, of better quality for bread production than Dawson's Golden Chaff, high yielder.

Spring Rye.

O.A.C. No. 61.—Good straw of medium height, the highest yielder of all varieties of spring rye.

Winter Rye.

Petkus.—Very hardy, vigorous grower, highest yielder of all varieties of winter rye.

Mammoth White.—Very hardy, vigorous grower, the second highest yielder.

Field Peas.

Arthur.—Medium late, medium [illegible] white blossom, medium-sized white grain, large yielder.

Canadian Beauty.—Late, heavy [illegible] white blossom, large white grain, large yielder.

Potter.—Medium late, medium [illegible] white blossom, medium-sized white grain, large yielder.

Golden Vine.—Late, heavy straw, white blossom, small white grain, medium yielder.

Field Beans.

Common White Pea.—Medium early, medium straw, small white grain, good yielder.

Soy or Soja Beans.

O.A.C. No. 111.—Medium early, vigorous grower, yellow beans, heavy yielder of fodder.

O.A.C. No. 81.—Early, yellow beans, heavy yielder of grain.

Brown.—Very early, brown beans, heavy yielder of grain.

Vetches.

Hairy.—Can be sown alone in fall or spring, used for fodder, cover crop, green manure and to a limited extent for seed production. Autumn seeding usually gives best results. Seed very expensive at present.

Buckwheat.

Rough or Rye.—Early, medium yield of straw, grain with rough thick hull, very heavy yielder.

Silver Hull.—Medium early, heavy yield of straw, grain with smooth hull, fair yielder.

Flax.

Common.—Medium height, blue flowers, quantity of fibre and seed varying with care, soil and season.

Mixed Grains.

Grain Production.—O.A.C. No. 3 oats, 1 bushel per acre. O.A.C. No. 21 barley, 1 bushel per acre.

Green Fodder or Hay.—O.A.C. No. 72 oats, 2 bushels per acre. Multiplier peas, 1 bushel per acre.

Annual Pasture.—Joanette, O.A.C. No. 72 or Banner oats, 3 bushels per acre. Common Red clover seed, 7 pounds per acre.

Sweet Corn for Table Use.

Golden Bantam.—Early, yellow, eight-rowed ears, best of about fifty varieties for home use.

Flint Corn.

Compton's Early.—Early, medium yield of stalks, yellow twelve-rowed ears, good yielder of grain, suitable for silage in more northerly districts of older Ontario.

Salzer's North Dakota.—Medium early, heavy yielder of stalks, white eight-rowed ears, crop suitable for husking or for the silo in central Ontario.

Dent Corn.

White Cap Yellow Dent.—Medium early to medium late according to strain, grown for grain in southern Ontario and for fodder and silage in central Ontario.

Wisconsin No. 7.—Medium in earliness, usually matures in the extreme southerly parts of Ontario, suitable for the silo in the warmer parts of the Province.

Sorghum.

Early Amber Sugar Sorghum, usually called *Sugar Cane.*—Grows about eight feet tall and resembles corn in appearance, but produces the seed on the top of the plants. Yields nearly equal to White Cap Yellow Dent corn, used for fodder and occasionally for syrup production.

Millet.

Japanese.—Late, heavy producer of green fodder and of hay, uncertain producer of seed, which is usually high in price.

Siberian.—Early, red seed, medium producer of both seed and fodder.

Hungarian Grass.—Early, light and dark seed, medium producer of both seed and fodder.

Rape.

Dwarf Essex.—Average yield more than corn, used as pasture or as green fodder, relished by cattle, sheep and hogs, very fattening, taints milk when fed to dairy cows.

Potatoes.

Irish Cobbler.—Early, white, good yielder, good quality.

Green Mountain.—Late, white, excellent shape, good yielder, good quality.

Mangels.

Yellow Leviathan.—Intermediate in length, good shape, high yielder, excellent quality.

Ideal.—Yellow, tankard shape, high yielder.

Sutton's Mammoth Long Red.—High yielder.

Sugar Mangels.

Giant White Feeding.—Intermediate in length, sugar content between mangels and sugar beets, yield of roots lower than mangels.

Royal Giant.—Pink skin, intermediate in length, sugar content between mangels and sugar beets, yield per acre lower than mangels.

Sugar Beets.

Dominion Sugar Company Selection.—Ontario grown seed, very high sugar content.

Kleinwanzlebener.—Imported seed, was used extensively in America for sugar production.

Swede Turnips.

Garton's Model.—Bronze top, high yielder, good quality.

Giant King.—Purple top, high yielder, good quality.

Perfect Model.—Purple top, high yielder, excellent quality.

Fall Turnips.

Red Top White Globe.—Very high yielder and excellent for early use in the fall.

Field Carrots.

Mammoth Short White.—Conical in form, good quality, high yielder. (All short white carrots offered by Ontario seedsmen are very similar.)

Grasses.

Timothy.—The popular variety for hay production, but not so suitable for pasture, especially in dry weather.

Orchard Grass.—A hardy perennial, used for hay when sown alone, but more suitable in a pasture mixture, starting growth early in the spring and continuing until late autumn.

Meadow Fescue.—A hardy perennial of good quality for hay or pasture, particularly suitable for use in a permanent pasture mixture.

Red Top.—A native perennial, particularly suitable for hay and pasture on low, damp land.

Clovers.

Common Red.—A biennial plant and the most valuable clover for Ontario, giving two crops per year.

Mammoth Red.—A late, coarse-growing clover, suitable for land which usually produces a light crop.

Alsike.—More suitable than Red clover for damp, shallow soil.

Alfalfa.

Grimm.—A perennial, deep-rooted legume, which is very hardy and which gives two or three crops annually for a series of years when well established under favorable conditions.

Ontario Variegated.—Very similar to the Grimm alfalfa and possessing about the same degree of hardiness.

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