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Stepping Up Rotation PASTURE Yields

A. C. ARNY

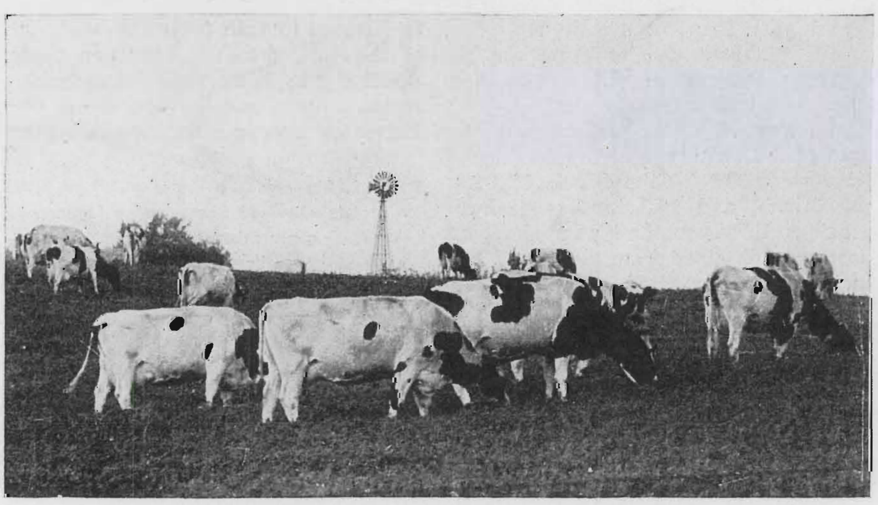
IN MINNESOTA, about 2 million acres of tillable farmland are devoted to rotation pasture. Investigations recently completed at University Farm and the branch stations at Waseca, Morris, and Crookston, show how to obtain the highest yields from these acres in 1944 and future years. Particularly striking were the differences found in yields when pastures were grazed at varying heights—differences averaging 30 to 50 per cent.

The work was planned to test the relative values of different legume-grass mixtures and the effect of different heights of grazing on yields. The different legume-grass mixtures—six at University Farm, five each at Waseca and Morris, and four at Crookston—were sown in triplicate plots laid out in long strips and cross fenced to make four pastures at University Farm and three at each of the other stations. One of these pastures was grazed as often as the growth reached an average of 4 inches, a second at the 8-inch average, and the third at the average height of 12 inches. At University Farm the fourth pasture was grazed at the early-hay stage.

When the plants on the 4-inch pasture reached that height, the growth on six square-yard areas was removed for yield determinations and protein analyses. Then the animals were turned in, kept there until the growth was well grazed down, and then removed. The areas grazed at the other heights were handled similarly. At University Farm only, cages were set over the harvested areas to determine the growth made during the grazing periods which varied from a week to 10 days.

Contents

An Olmsted County pasture of second-growth alfalfa in early September on farm of P. S. Hair. Grazing at this height, 8 to 12 inches, gives the happy combination of easy pickings for the cows plus high yield and quality of forage.



Results obtained in one of the trials at University Farm are given in table 1 to show how, over a 4-year period, grazing at different heights affected the yields.

The first year, the yield from the 4-inch grazing was only from 13 to 26 per cent lower than from the more lenient

Table 1. Yields of pasturage on a 15 per cent moisture basis from grazing legume-grass mixtures at different heights or stages of development

Height or Stage	Tons per acre				Average	
	1939	1940	1941	1942	Tons	Per cent
4-inch	2.27	1.11	0.88	2.46	1.68	100
8-inch	2.86	1.43	1.77	3.10	2.29	136
12-inch	2.62	2.35	2.90	3.99	2.97	177
Early hay	2.56	2.05	2.40	4.59	2.90	173

Pasture Produces Feed at Very Low Cost

Measured in terms of total digestible nutrients, permanent and rotation pastures produce feed at costs averaging 41 cents per hundred pounds as compared with an average of 88 cents for four harvested crops. Yields given in this table are averages for 5 to 8 years on good land with a rental value of $5 per acre. Because pasture crops are harvested by livestock, labor requirements average only about 2 hours per acre as compared to 12.9 hours for the harvested crops.

Kind of crop	Average yields per acre		Production cost per cwt. T.D.N.*	Hours man labor required per acre
	Tons or bu.	Pounds T.D.N.		
Permanent and rotation pasture crops				
Kentucky blue-white clover	1.2 tons	1,469	$0.44	2.0
Sweet clover	2.0	2,448	.35	2.0
Red clover-timothy	1.6	1,958	.49	2.0
Alfalfa-grass mixtures	2.3	2,815	.35	2.0
AVERAGE		2,173	.41	2.0
Supplementary pasture crops				
Second crop red clover-timothy	0.6 tons	734	$0.48	2.0
Second crop alfalfa-grass	0.8	979	.38	2.0
Sudan grass	1.5	1,836	.62	4.5
AVERAGE		1,183	.49	2.8
Harvested crops				
Corn	50 bu.	2,212	$0.77	10.6
Oats	50	1,144	1.33	8.0
Corn silage	8 tons	2,784	.79	17.0
Alfalfa-grass hay	2.5	2,515	.64	16.0
AVERAGE		2,164	$0.88	12.9

* Cost of production data supplied by Division of Agricultural Economics, University of Minnesota.

grazings. However, the effect of grazing at the 4-inch stage in 1939 influenced very materially the yields obtained in 1940 and the following years. In 1940 and 1941, the yields from the 4-inch grazing were less than one half and one third, respectively, of the yields obtained from the 12-inch grazing. In 1942, an exceptional season, the 4-inch grazing yielded 62 per cent lower than the 12-inch. Grazing at the early-hay stage, twice per season, gave yields, after waste had been deducted, similar to those obtained from the 12-inch grazing.

Average yields from the frequency-of-grazing determinations at the different locations are shown in table 2.

Table 2. Three-year average yields of pasturage on a 15 per cent moisture basis from grazing legume-grass mixtures rotationally at various heights

Height at grazing, inches	Tons per acre				Average	
	U. Farm	Waseca	Morris	Crookston	Tons	Per cent
4	1.42	1.98	1.68	1.37	1.61	100
8	2.02	2.55	2.48	1.35	2.10	130
12	2.62	3.08	2.37	1.50	2.39	148

At University Farm, the 8-inch grazing resulted in 42 per cent and the 12-inch resulted in 85 per cent increased yield over the 4-inch grazing. At Waseca, these increases were 29 and 56 per cent, respectively. At Morris, grazing at 8 inches resulted in an increase of 48 per cent over the 4-inch grazing. The 12-inch grazing yielded slightly lower than the 8-inch. At Crookston, the 8-inch grazing yielded slightly less than the 4-inch, and the 12-inch grazing yielded only 9.5 per cent higher than the 4-inch. Why the results obtained at Crookston are so different from those obtained at the other locations cannot be explained.

The average crude protein percentages of the pasturage at the four locations were 20.9 for the 4-inch, 18.8 for the 8-inch, and 16.8 for the 12-inch grazings. However, the higher yields of pasturage obtained from the 8- and 12-inch grazings resulted also in higher acre yields of crude protein. This is shown in table 3.

At University Farm, the gains for the 8- and 12-inch grazings over the 4-inch were 58 and 55 per cent, respectively. Gains for the 8- and 12-inch grazings of 13 and 26 per cent, respectively, over the 4-inch were obtained at Waseca. At Morris, the gains for the 8- and 12-inch over the 4-inch grazing were 40 and 16 per cent. At Crookston, about 10 per cent lower yields of crude protein were obtained from the more lenient grazings. The average gains were 26 and 23 per cent for the 8- and 12-inch grazings over the 4-inch. These were substantial increases.

Legume-grass Mixtures Studied

Grazed at the 4-inch height, all the mixtures were low and similar in yield. Although a considerable number of alfalfa plants, an average of 23 plants per square yard, lived throughout the 3-year period, they were so weakened by the severe treatment that they did not produce much growth. When grazed at the 8- and 12-inch heights, averages of 28 and 39 strong, vigorous plants per square yard remained at the close of the third season. Under these more lenient grazings, the alfalfa-grass mixtures yielded significantly higher than the red clover-grass and the sweet clover-grass mixtures. Had there been fresh stands of red clover- and sweet clover-grass mixtures for yield determinations each of the 3 years, the differences in favor of the alfalfa-grass mixtures would not have been so great.

At University Farm and Waseca, legume-timothy mixtures yielded as high as legume-brome grass mixtures. In the western part of the state, good legume-timothy stands were not obtained and legume-brome grass mixtures proved best.

Results from these grazing trials point the way on a large majority of farms to obtain increased yields from rotation pastures of from 30 to 50 per cent or more by letting the growth reach 8 to 12 inches each time before turning the livestock in.

One way of doing this is to divide up each large rotation pasture into four or five smaller areas by means of electric fence. Each area may then be grazed and rested in turn until a new growth of the desired height has been made. Another way is to graze the growth in rotation pastures no closer than 5 to 6 inches at any time during the season.

Table 3. Three-year average yields of crude protein obtained from grazing legume-grass mixtures at three different heights

Height at grazing, inches	Pounds per acre				Average	
	U. Farm	Waseca	Morris	Crookston	Pounds	Per cent
4	522	709	598	453	571	100
8	822	803	836	414	719	126
12	808	893	692	408	700	123

Makes Steers Give Milk . . .

STILBESTROL Helps Solve Sterility

W. E. PETERSEN AND W. L. BOYD

COWS THAT HAVE never had a calf—yes, even bulls and steers—may be made to give milk. Fantastic as it may seem, those very facts have been accomplished in experiments at University Farm by the use of a new drug known as diethylstilbestrol—stilbestrol, for short. This new drug has several other possible uses. It is beneficial in the treatment of certain cases of sterility, in the expulsion of retained placentas and mummified fetuses, and in the treatment of various uterine diseased conditions.

Use Still Experimental

Before going further it should be emphasized that the use of this drug is still in the experimental stages. While a number of sterile heifers and older nonbreeder cows have been brought into satisfactory milk production, there are others that have not responded satisfactorily. Work is now in progress to find out why there is failure in some cases and how to overcome it. It is hopeful that in the future sterile heifers and cows may be brought into full milk production and even a fair proportion of them may be restored to a breeding condition.

Diethylstilbestrol is a synthetic drug that has the same action as the female sex hormone known as estrogen. It cannot be called a hormone since it differs chemically from the natural hormone and, besides, a hormone is secreted by a gland. Stilbestrol is also a drug that must be used only by or under the direction of a veterinarian or physician. It is administered by first dissolving it in oil and then injecting the solution under the skin. Other routes of administration may be effective, particularly giving it by way of mouth, but this remains to be determined.

The action of the drug is most striking in its effect upon the udder. For this purpose injection of 20 to 40 milligrams dissolved in oil three times a week until the udder is fairly well developed and filled with milk seems to be the best procedure. The dose should be graded according to size and weight, the amounts given being for 700-pound and 1,200-pound animals, respectively.

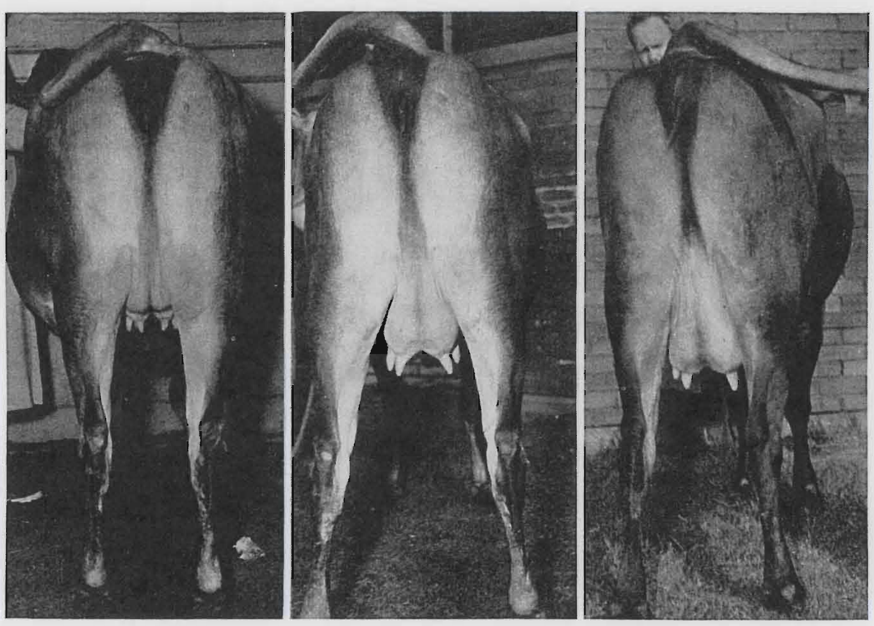
The effect of injection of stilbestrol upon udder development and milk secretion has been studied in calves and heifers of all ages, nonbreeding heifers and cows not in milk, freemartins, milking cows, bulls, and one steer. In all cases there has been udder development and milk secretion, though the degree of response has varied greatly.

The response has been the greatest in two-year-old nonbreeder heifers where, in the great majority of cases, the udder has developed to about the size expected following a normal calving and the level of milk production has been equally satisfactory. Pictures are shown of one such heifer when the treatment started, three weeks later, and when the udder was fully developed. This heifer was milked for 305 days and then dried off. She was milked twice daily and given ordinary care. During this time she produced 3,560.7 pounds milk and 220.6 pounds of fat. Another similar heifer was milked for one year during which time she produced 4,120.9 pounds milk and 251.4 pounds of fat. A number of practicing veterinarians have cooperated on this project. Reports from them are far from complete. In two cases, at least, nonbreeding two-year-old heifers brought into milk by the stilbestrol treatment have produced more milk and fat than their sisters produced following normal calving. In a few cases the results have been disappointing.

Attempts at bringing older, dry nonbreeding cows into milk have been tried at University Farm in five instances. While some udder development and milk production was obtained, in no case was either equal to what would be expected following a normal calving. Veterinarians for the most part have had similar experiences, but occasionally very satisfactory results have been obtained. One mature Jersey for four consecutive months has produced over 50 pounds of butterfat per month.

In calves, the amount of udder development and milk secretion obtained from the treatment is small. As a rule the development does not take place in all quarters. As the age of the treated heifers increases there is increased udder development and milk secretion and the effect upon the quarters becomes more uniform.

In the freemartin (a heifer twinned with a bull) the results of treatment have proven disappointing. Three such animals have been studied and in no

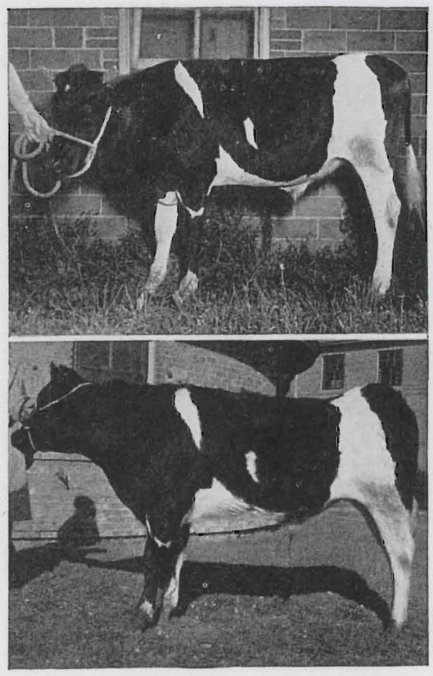


Injections with stilbestrol brought this sterile Jersey heifer into milk without calving. In 305 days she produced 220 pounds of fat. Left to right—heifer at start of treatment, 3 weeks later, and 3 months later.

case was the udder development more than a fraction of that obtained in the normal. As in younger normal heifers, the different quarters were unevenly affected.

The treatment of the bull and steer proved interesting. Injections in both were continued over a period of five months. In both, there was a small development of the mammary gland and a few cc. of milk could be obtained daily. The milk was normal in appearance and composition. As stilbestrol has the properties of the female sex hormone, the effect upon the temperament of the steer was of interest. At the beginning of the experiment he was docile and easy to handle. After several months of injections he became more pugnacious. Another effect of the treatment was a decided rise in the tail head as may be noted in the illustrations. This is a characteristic observed in nonbreeder cows with chronic cystic ovaries.

In the bull, the treatments tended to make him more feminine in appearance. There was no noticeable change in temperament, but after several months of injection he became sterile. The sterility effects were only temporary as within two months after the treatment had stopped he was restored to a fertile condition. The masculine characteristics also developed again after treatment was stopped.



Steer treated with stilbestrol. Top—beginning of treatment; bottom—after 5 months. Note the raised tail head.

It is still too early to make positive statements about uses of stilbestrol in the treatment of abnormal conditions that occur in cattle. The evidence obtained to date indicates that its use is promising in the treatment of retained placentas, mummified fetuses, infections of the uterus, and certain types of sterility.

The fundamental effects of stilbestrol upon the reproductive organs of the female are such as to support the beneficial effects observed in the treatment of the aforementioned conditions. One of the most prominent effects of stilbestrol administration is the development of a state of estrus (heat). Breeding at this time is not indicated as there is no ovulation (escape of egg). As a rule a spontaneous estrus appears within one or two weeks following the withdrawal of treatment. This estrus is accompanied by ovulation and breeding is indicated. The inhibitory effect of stilbestrol upon ovulation is the reason that the treatment may be helpful in those cases of sterility caused by a derangement of the hormonal system in the cow. The temporary prevention of ovulation may give the ovary the needed rest for subsequent normal functioning.

Stilbestrol stimulates growth of the inner lining of the uterus with an increased blood supply. This and other effects upon the uterus explains why its use helps in clearing up infections and expelling mummified fetuses and retained placentas. Because of this fundamental effect of the drug it will also cause abortion if administered in large doses to a pregnant animal, especially one in early pregnancy.

Making More Pork from Less PROTEIN

E. F. FERRIN

BECAUSE OF THE protein scarcity, wartime hog producers are asking how far they can go in reducing the use of protein without too much sacrifice of gains or too much waste of other feeds. They want practical suggestions for getting the most pork per pound of protein available.

Protein is a nutrient that animals just cannot do without. Every cell in the animal body must have nitrogen from the protein compounds to grow and to keep alive. No other chemical element in feeds can be substituted for this nitrogen so that the health and thrift of farm livestock, young animals especially, is to a large extent dependent upon the protein supply.

The quality of a protein depends on the number of the essential amino acids it contains and also on the amounts of nitrogen supplied by these compounds.

Professor Ferrin gives Farm and Home Week visitors some pointers on what to look for in choosing breeding stock.

Essential amino acids are nitrogen compounds which cannot be synthesized in the digestive tracts of animals and so must be present in the rations. Of the total 22 amino acids, 10 are classed as essential.

Pigs and chickens need a higher quality of nitrogen compounds in their rations than do cattle and sheep which have a paunch where bacteria and protozoa convert low-quality nitrogen compounds into high-quality nitrogen compounds.

The present shortage of high-protein feeds results from our having more livestock to feed than ever before and from the fact that more people would like to feed rations higher in protein than normal. The problems of hog and poultry feeders have been increased by a shift in the proportions of animal and vegetable protein feeds now on the market. Before Pearl Harbor there was approximately one ton of animal-source protein feeds for each ton from vege-

THREE RULES FOR CONSERVING PROTEIN

- Use animal-protein feeds sparingly for hogs by combining them with vegetable-protein feeds.
- Use pasture crops to the fullest advantage by choosing only the best crops and getting the greatest possible value from them through good management.
- Hand-feed protein concentrates or mix them with ground grains instead of feeding free-choice.

table sources. Now there is only about one ton to each 5 or 6 tons of vegetable proteins. The feeds of animal origin like skim milk, tankage, and fishmeal have a higher quality of protein than linseed meal, cottonseed meal, wheat middlings, and others. The vegetable proteins which come nearest to replacing animal proteins are soybean oil meal and peanut meal. There will be some increase in these two feeds in 1944 but not enough to relieve the pinch of shortage.

The supply of animal-protein feeds is so small that its use must be restricted to the periods of life of poultry and pigs when the need is most critical. For hogs these times of greatest need are for pregnant and nursing sows and for growing pigs up to about 70 pounds.

Further economy in the use of animal-protein feeds for hogs can be accomplished by mixing with vegetable proteins. Just as a few drops of ethyl fluid will improve a whole gallon of gasoline, so a few pounds of good animal-protein will increase the nutritive value of many pounds of poorer-quality vegetable proteins. Four pounds of animal protein to 96 pounds of vegetable proteins, if from several sources, will make a mixture of reasonably good quality. Another way to economize in the use of protein for hogs has been demonstrated by the Minnesota and Indiana Experiment Stations. This is to feed a mixture of grains, especially wheat and corn, instead of corn alone.

Good Pasture Saves Protein

There is no better way to reduce the need for protein concentrates and save money than to get the most use out of hog pastures. The championship for high-value pastures goes to alfalfa or mixtures of alfalfa and grasses, especially brome grass. Some people hesitate to pasture hogs on alfalfa because a part of the seeding is killed out, but this seems small when it is realized that an acre of good hog pasture saves about 1,000 pounds of grain and 500 pounds of protein concentrate.

Another factor in making the best use of pasture is to see that the hogs always have fresh, green, tender plants to graze. Up to the time an alfalfa plant is 10 inches tall it contains 5.5 to 6 per cent of protein; after blooming, only about 3 per cent. A simple way to take advantage of this fact is to fence the alfalfa pasture into two fields, alternately grazing and mowing the alfalfa for hay.

Another means for skimping on protein feeds is to allow the pigs a little less protein than the optimum amounts which will likely result in a slower rate of gain and a little more feed to make 100 pounds of gain. Possibilities were demonstrated at University Farm during the summer of 1943 with three groups of pigs fed in dry lots from July 8 to September 30. They were self-fed a mixture of ground wheat, alfalfa meal, and enough tankage and soybean oil meal in equal parts to make three different levels of protein. Each lot also received cod liver oil and a mineral mixture. At the start, when the pigs averaged 73 pounds, Lot 1 received a high level of protein, 20 per cent in the mixed ration; Lot 2, 17½ per cent protein; and Lot 3, 15 per cent protein. As the pigs in each lot reached 125 pounds, the protein percentages were lowered to 17½ per cent, 15 per cent, and 13.6 per cent, respectively, the latter level being furnished by the wheat and alfalfa meal without tankage or soybean oil meal. The data condensed from the records of these three lots appears in the accompanying table.

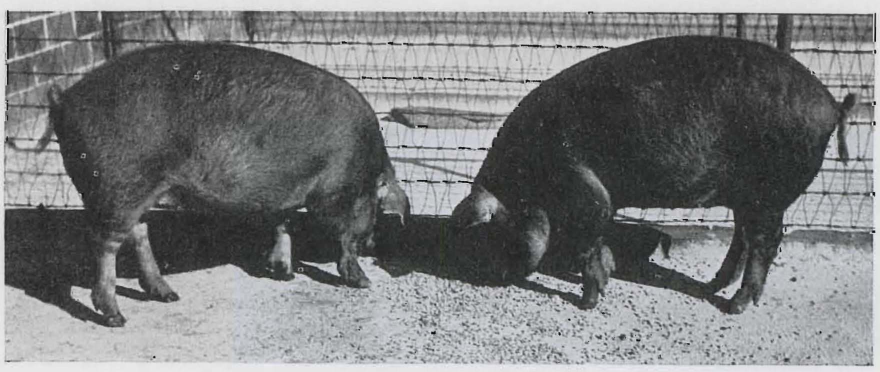
The pigs receiving the medium and low levels of protein ate larger amounts of wheat, but saved enough tankage and soybean oil meal to bring the costs of 100 pounds gain below that of the higher protein level by 27 cents and 58 cents, respectively. Lot 1 ate 315 pounds of wheat; Lot 2, 344 pounds; and Lot 3, 359 pounds for each 100 pounds of gain in weight. The total feeds for gains made were so nearly the same that it was practically a toss-up among the three lots.

It should be noted that the rations used did not represent any wide extremes in protein allowances. The high-protein lot received little more than the optimum level, and the low-protein ration did not handicap the pigs badly in the amount of protein needed for growth and thrift.

Results of Using Three Different Levels of Protein in Rations for Growing Pigs

	Lot number and level of protein fed		
	1 High	2 Medium	3 Low
Average initial weight per pig, pounds	73	73	73
Average final weight per pig, pounds	192	185	183
Average daily gain per pig, pounds	1.42	1.33	1.31
Average daily ration per pig, pounds	5.81	5.53	5.40
Total feeds for 100 pounds gain, pounds	411.	415.	412.
Feed cost for 100 pounds gain*	$8.20	$7.93	$7.62

* Feed prices: Ground wheat, $1.11 per bu.; alfalfa meal, $1.50 per cwt.; tankage, $3.85 per cwt.; soybean oil meal, $2.50 per cwt.; mineral mixture, $3.00 per cwt.



These two pigs were typical of the high-protein and low-protein lots of the experiment discussed. The low-protein pigs (animal at right) were a few pounds lighter and carried a trifle less finish. Protein levels used varied from 13.6 to 17 per cent.

Pick the Crops That Yield MORE FEED

As a feed producer, corn far excels other grain crops in yields per acre or per man-hour. Alfalfa does even better. See Table 1.

G. A. POND

THE 1944 WAR FOOD production goals call for substantial increases over the high level achieved in 1943. Most of the food produced on Minnesota farms is marketed as livestock and livestock products, so that to increase food production we must first increase feed production. Since there is little new land that could be brought into cultivation and a lack of machinery and manpower to develop it if there were, we must secure this increased feed production largely from our present acres. The greatest opportunity for achieving this lies in a more discriminating choice of crops. Table 1 gives a basis for such a selection.

Some of the common feed crops of the state are compared on the basis of the quantity of total digestible nutrients and of digestible protein they produce with normal yields. Since oats is the most widely grown feed crop, it is used as a base with a rating of 100. These comparisons are shown for each type-of-farming area in the state (see map). For the state as a whole and in most type-of-farming areas, an acre of corn or alfalfa will produce as much digestible feed as 2 acres of small grain. Alfalfa has the additional advantage that it produces three to five times as much digestible protein.

The advantages of corn and alfalfa as feed crops are further emphasized by the data in table 2, obtained from farm records in southeastern Minnesota. With the average yields obtained on these farms, corn will produce 2,373 pounds of digestible feed per acre. A bushel of oats contains 22.24 pounds of digestible feed. To produce as many pounds of digestible feed with oats as with corn would require a yield of 107 bushels (2,373 ÷ 22.24). Even the recently introduced varieties such as Vicland, Tama, and Boone do not produce yields even approaching 107 bushels on these farms. Corn and alfalfa not only produce more feed per acre and per hour of man labor than the other feed crops, but they produce it at a much lower cost per hundred pounds.

The opportunity for increasing feed production by increasing the proportion of land in corn and alfalfa is indicated in table 3. In the first column is shown a cropping system with the distribution between oats, barley, corn, and hay substantially as they have been for the past 15 years on these farms. In proposed systems 1 and 2 corn and alfalfa have been increased at the expense of oats and barley. The production of digestible feed is greatest under proposed system 1, but slightly more labor would be required than at present. If 8 acres of alfalfa were pastured as suggested under proposed system 2, nearly as much feed would be produced (assuming 75 per cent as much feed could be obtained from pasturing as from hay) and the labor would be better distributed through the season. The greatest number of hours required in any one week would be less than under the present system.

In spite of the marked increase in feed production obtained by increasing the proportion of land in corn and alfalfa, there are certain limitations to be considered. Corn is generally recognized as a soil-depleting crop. Soil specialists estimate that, in the more level areas, 50 per cent of the land in corn or other cultivated crop is about the upper limit of safety from a soil

Table 1. Comparisons between Crops in Production per Acre of Digestible Nutrients*

Crop	Type-of-farming areas									State
	1	2	3	4	5	6	7	8	9	average
Index of total digestible nutrient production per acre (oats = 100)										
Oats	100	100	100	100	100	100	100	100	100	100
Spring wheat	92	86	79	84	82	94	98	106	97	85
Rye	97	98	92	96	98	106	111	101	107	95
Winter wheat	111	111	96	95	110	107	112	121	113	116
Barley	121	125	121	127	128	131	134	135	135	125
Corn	257	235	228	217	204	211	201	195	224	237
Alfalfa	324	342	287	277	335	259	222	249	388	284
Index of digestible protein per acre (oats = 100)										
Oats	100	100	100	100	100	100	100	100	100	100
Spring wheat	55	52	48	51	49	56	60	63	58	51
Rye	61	60	57	59	61	66	61	62	57	58
Winter wheat	66	66	57	58	66	65	60	73	68	69
Barley	104	108	104	109	109	113	115	116	115	106
Corn	128	118	114	108	101	105	100	98	111	117
Alfalfa	446	471	397	383	461	357	308	344	532	389

* Average yields, 1918-1942, except corn yields which have been adjusted for use of hybrid varieties.

Table 2. Comparative Crop Returns and Costs

Crop	Yield per acre*	Pounds T.D.N.† per acre	Bushels or tons to equal corn in T.D.N.	Pounds T.D.N. per hour man labor	Cost per 100 lbs. T.D.N.
Corn	52 bu.	2,373	......	221	$0.71
Oats	43 bu.	956	107	127	1.58
Barley	30 bu.	1,117	64	149	1.32
Wheat, winter	20 bu.	950	50	127	1.59
Wheat, spring	17 bu.	808	50	108	1.84
Rye	17 bu.	780	52	104	1.84
Alfalfa hay	2.4 tons	2,472	2.3	225	.66
Corn silage	8.3 tons	2,789	7.1	155	.81

* Average yield of 150 farms in Southeast Minnesota Farm Management Service, 1928-1942 inclusive. In computing the average yield of corn the yields for those years in which open-pollinated seed was used have been increased by 15 per cent to make them comparable with yields of the more recent years when hybrid seed was used.

† Total digestible nutrients. Analysis of these feeds was obtained from "Feeding the Dairy Herd," Minn. Agr. Ext. Bul. 218 (June 1941).

Table 3. Comparative Feed Production with Different Cropping Systems

	Cropping system		
		Proposed	
	Present	No. 1	No. 2
Acres of crops			
Oats	35	10	10
Barley	15	15	15
Corn	33	50	50
Alfalfa hay	17	25	17
Alfalfa pasture	......	......	8
Total	100	100	100
Pounds of T.D.N.	170,548	206,765	201,821
Hours of labor	917	1,000	928
T.D.N. per hour of labor	186	207	217
Cost per 100 lbs. of T.D.N.	$.93	$.79	$.77

conservation standpoint. In the more rolling areas, one third of the land in corn would be a safe general limit, and special soil-conserving practices such as strip cropping and contour tillage should be used wherever corn is planted on sloping land. In northern Minnesota, climatic conditions limit corn production very definitely, although some of the new short-season hybrids have pushed the limits of successful corn production northward.

Alfalfa is not subject to climatic limitations, but in some areas the low lime content of the soil limits its adaptation. To a considerable extent this can be offset by the use of ground limestone or marl prior to seeding. There is the additional limitation of time. It is too late now to seed alfalfa for harvest in 1944. For this year the farmer must get along with the seedings previously established. However, it is quite important that plans be made at once for new seedings this year. The demand for more and better feed will continue in 1945 and beyond.

A large increase in the acreage of corn and alfalfa will do more than anything else to step up our feed production in response to the wartime needs for livestock and livestock products. Even under normal conditions a substantial increase of these crops would be desirable from the standpoint of an increased quantity and quality of feed production at minimum cost. Alfalfa is also needed from a soil conservation standpoint. In the present emergency we are justified in expanding our corn acreage even more than would be desirable from a long-time soil conservation standpoint. Substantial reserves of plant food have been built up in the soil in recent years. Now is the time to draw on them. We cannot, however, afford to increase our corn acreage to the point of incurring serious soil losses. Depleted reserves of plant food can be restored, but lost soil cannot be replaced.

The stress given feed production in this article is not intended to imply that feeding crops should be raised to the exclusion of cash crops. Flax, soybeans, hemp, vegetables for canning, and dry beans and peas are all vital war crops. They should be grown where adapted, at least up to the extent of the suggested quotas. The present article applies only to the selection of crops on that portion of the farm used in raising feed for livestock.

Hybrid Corn—Its Origin and Value

(Concluded from Page 16)

(AxC) (BxD), and (AxD) (BxC). The yielding ability of each of the three double crosses is predicted by averaging the four possible single crosses that measure the combining ability of the inbred parents from one single cross with the inbreds of the other. For (AxB) (CxD), the method as illustrated in table 2 consists of averaging the yields and moisture content of the single crosses, AxC, AxD, BxC, BxD. The double cross that yields the best from the three that can be produced from each group of four inbreds is obtained by using as single-cross parents the two possible single crosses that yield the lowest out of the six single crosses available. It is of interest that Jenkins, on purely theoretical genetic analysis, thought the method the most logical of those that he suggested.

At the time that the performance of Minhybrid 408 was predicted a rather large number of other double crosses were predicted also. A good idea of their relative value in relation to hybrids already available was obtained by growing Minhybrid 403, a well known double cross, with the single crosses used in prediction. In these trials Minhybrid 403 yielded 66.8 bushels with a moisture content of 23.6 per cent at husking, a much lower yield than that predicted for Minhybrid 408 as given in table 2. From trials made in 1942 and 1943, Minhybrid 408 has given further evidence of its desirability in the Southern zone.

Before releasing a new hybrid it is tested for at least three years and then if sufficiently desirable is approved by the Minnesota Agricultural Experiment Station. The predicted yields are accepted in the place of actual yields for the first year of double-cross test.

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An extreme case of phosphorus deficiency. The phosphate treatment on the right increased the yield of alfalfa 1.3 tons per acre.

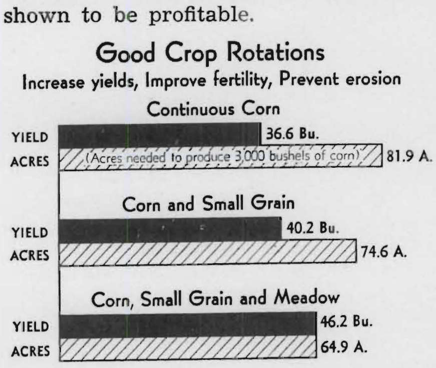
Legumes do best on soil with a high level of mineral nutrients. The alfalfa plot on the right was treated with 20 per cent superphosphate (Steele County).

SOIL UPKEEP in Wartime Farming

C. O. ROST AND P. M. BURSON

IN TIME OF WAR the tempo of agricultural production must be increased and the increase must be progressive from year to year until the victory is won. Thus, the production goals for 1942 exceeded those for 1941 and those for 1943 were larger still. The goals for 1944 have been set even higher. The question is at once raised, "Can we continue to intensify production without doing irreparable harm to our land?"

Although a declining soil fertility is an ever-present problem, wartime conditions make it necessary to adhere more rigidly to a program of good soil management in order that the rate of depletion may be reduced to a minimum. The principles of such a program have long been practiced. These include (1) a rotation of crops in which there is a proper distribution of soil-conserving and soil-depleting crops, (2) the return of crop residues to the land, (3) the conservation and application of animal manures produced on the farm, (4) the use of good cultural and erosion control practices, and (5) the application of lime and commercial fertilizers where their use has been shown to be profitable.



Black bars show how rotation of crops increases corn yields, while light bars emphasize how the acreage needed to produce 3,000 bushels of corn decreases as yields go up. (Yields from Minn. Tech. Bul. 149.)

It must be remembered at the outset that soil depletion is a gradual process and does not appear abruptly. Signs of its approach are evident long before irreparable damage has been done. These signs include slowly declining yields, depletion of the organic matter of the soil, increasing difficulty in obtaining stands of legumes, soil washing or erosion, a poor physical condition of the soil, and response to lime and commercial fertilizers. Recognizing these signs and adopting measures to remedy the conditions and restore the productivity of the land constitutes true soil conservation.

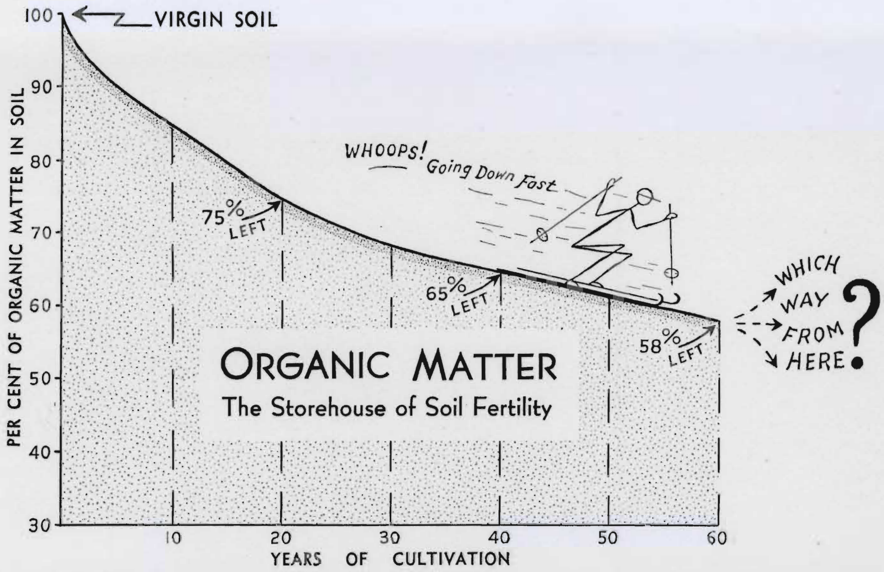
How soon the first signs of declining soil fertility may appear is dependent on a number of factors. One of the most important is the native or natural fertility with which the land was originally endowed. Fortunately this native fertility was remarkably high in a large part of our Minnesota soils. Under natural conditions there was a truly conserving environment. All nutrients removed were returned again to the soil in the residue of dead plants and the decaying remains maintained organic matter at a high level. When the natural balance was disturbed by the production of agricultural crops, we passed from a conserving situation to a depleting one. We began at that time to draw on our account in the State Bank of Soil Fertility and deposits have never quite equalled withdrawals.

No cropping system, regardless of how good, will, in itself, completely maintain the fertility balance of the land. Moreover, the more efficient the farmer is in maintaining high production the more rapidly will fertility leave his farm. All crops, livestock, and livestock products sold from the farm remove fertility and the greater the volume of these products the more rapid will be the removal. An indication of the really tremendous amounts of plant food removed in cash crops is seen when we consider the withdrawals

Effect of fertilizer on corn in southwestern Minnesota in 1942.

made by wheat, flax, and potatoes in 1942 for the state of Minnesota. Were the fertility removed by these three crops to be repurchased in the form of commercial fertilizer in tonnages of sulphate of ammonia (nitrogen), 20 per cent superphosphate (phosphorus) and 50 per cent muriate of potash (potassium), a total of 324,000 tons would be required. While this may seem large, the total would be greatly increased if we added the fertility removed and sold in other market grains, and in beef, pork, mutton, poultry products, and market milk. It would be no exaggeration to say that the equivalent of at least a half million tons of commercial fertilizer are removed from Minnesota farms each year in cash crops, livestock, and livestock products. In 1943 the farmers of Minnesota purchased approximately 59,000 tons of commercial fertilizer or approximately 10 per cent of the nutrients sold from our farms.

Although our oldest fields have been farmed for scarcely 100 years, signs of declining soil fertility are already much in evidence. Proof is found in the results of many fertilizer trials conducted by the Division of Soils. As long as 25



After 60 years of cultivation, the total organic matter of our Minnesota soils has been reduced about 42 per cent. Further decreases will limit crop production. The problem of maintenance lies in the selection of adaptable crop rotations and the use of proper soil fertility and management practices.

years ago, applications of phosphate fertilizers produced definite increases in yield. At that time little or no increase was obtained with potash fertilizers. In 1943 many fields showed distinctly greater increases in yield from mixtures of phosphate and potash than from phosphate only. This indicates our reserves of potash, as well as phosphate, are gradually being reduced and it is now time to look to measures which will maintain these mineral nutrients at levels which will insure a sustained high level of production. There is no way of replacing phosphate and potash other than to repurchase them in the form of commercial fertilizer.

Any consideration of mineral nutrients should include lime as well as phosphate and potash. Fortunately a large proportion of Minnesota soils are well supplied with lime. In some sections the soils are acid and lime is now essential to the successful growing of alfalfa and sweet clover. Soil tests for acidity will indicate the need for lime for these crops. In general, it may be said that the soils of the western half of the state will need lime only in exceptional cases. In the eastern part its use should be based on soil tests.

There is also evidence that on many fields the soil organic matter, which contains the nitrogen used by crops, has become reduced to a point where the amounts returned to the land in crop residues, barnyard manure, and by legumes are not sufficient to insure maximum yields.

Experiments conducted by mid-west experiment stations have shown that in this region the reductions of soil organic matter have been in the order of 25, 10, and 7 per cent for successive 20-year periods during which the land has been farmed. This would mean that the organic matter content of our soils has been decreased by approximately 42 per cent in the first 60 years of cultivation. It is impossible to maintain organic matter at the level existing in the virgin state but entirely possible to maintain a level adequate to keep the soil in good tilth, reduce its susceptibility to erosion, and maintain a relatively high level of nitrogen for crop production.

The organic matter supply of the soil rests in the hands of the farmer. Any system of farming which induces a steadily decreasing supply of soil organic matter will not continuously maintain maximum yields. A system which will maintain the organic matter of the soil calls for (1) a rotation of crops which includes the growing of an inoculated legume, (2) the return to the land of crop residues, and (3) the conservation and application of the manure produced on the farm. Good crop rotations are based on the principle that there should be a balance between soil-depleting crops (corn, potatoes, etc.) and soil-conserving crops (legumes and grass mixtures) according to the characteristics of the soil (type, slope, and degree of erosion).

Barnyard manure is the most common and least appreciated fertilizing material available. Besides organic matter it contains both nitrogen and mineral plant nutrients, one ton being equivalent to 100 pounds of a 10-5-10 fertilizer. About three-fourths of the plant nutrients fed to livestock may be recovered in the manure and returned to the land if the manure is properly stored and handled. If improperly handled, heating and leaching will remove most of the soluble material.

Proper cultivation is a very important factor in efficient crop production. While it serves many useful purposes only two need to be mentioned here. The importance of the preparation of a good seedbed cannot be overestimated. It will insure better stands not only of legumes and grasses but of other crops as well. It is good insurance against the failure of the legumes so essential to the success of our livestock program. A second important function of cultivation is to control weeds and thereby eliminate their competition with crops for available moisture and nutrients.

There is an opportunity then for the farmers of Minnesota to reduce the impact of the intensive production of wartime on the fertility of their fields. A program for this would include:

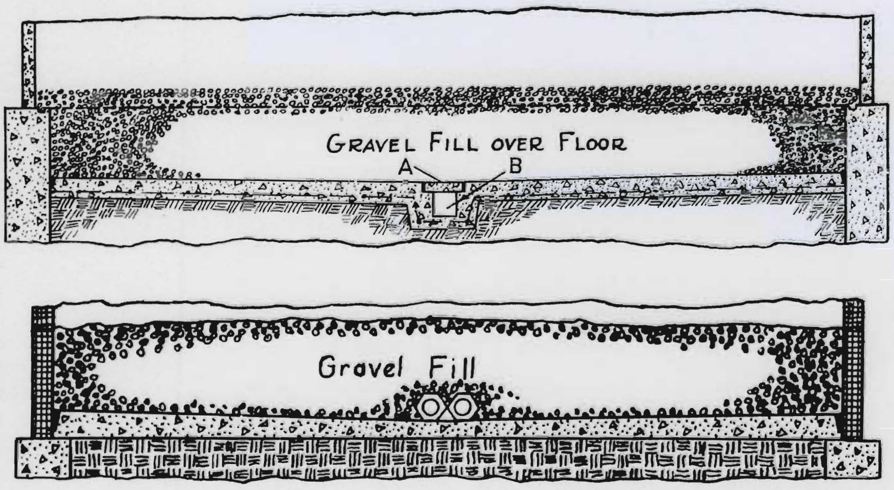
1. Maintain a good rotation including an inoculated legume and other crops adapted to soil conditions. This will increase organic matter and nitrogen in the soil and reduce erosion.
2. Conserve and use barnyard manure and crop residues.
3. Use commercial fertilizers to the limit of the supply available.
4. Continue to use lime, where needed, for the growing of alfalfa and sweet clover.
5. Improve cultural practices especially as these relate to seedbed preparation and control of weeds.
6. Use simple erosion control practices such as grassed waterways and contour cultivation.

Barnyard manure is an excellent fertilizer and, being high in organic matter, is especially effective on sandy soils. These pictures show the marked improvement in corn from applying 20 tons of manure per acre.

SILO Drainage Stops a Nuisance

CHARLES G. SNYDER

THE GROWING practice of filling silos with legume or corn crops of high moisture content makes it desirable to have some means of draining off the surplus juices. A silo built for ensiling corn at the usual moisture content of 68 to 72 per cent will need additional reinforcing steel to counteract the higher pressures of wetter silage. Otherwise, even though the structure may not fail completely, the extra stress on the reinforcing steel will allow cracks in the wall to open up, thus increasing the tendency for the silo to leak. Juice leaking from a silo will remove galvanizing almost immediately, corrode steel, concrete, and mortars, and in addition will make the silo and the adjacent barn yard unsightly and smelly.



Two plans for draining silos. Above—floor sloping to 4 x 4-inch trough (B) extending the full diameter of the silo and covered with loose-fitting concrete slabs (A). Below—drain of six-sided tile for floors already in place. Both plans include a 20-inch fill of coarse gravel.

High Silos Not Desirable

If a silo is much over 25 feet high, wet silage will have some of its moisture squeezed out when the silo is filled. Whenever the height exceeds 40 or 45 feet, excessive leakage is almost sure to result if filled with wet silage. This moisture may accumulate in the bottom of the silo where it will waterlog and make unpalatable the lower portion of the silage, unless the soil is sandy enough to permit ready drainage or an adequate drainage system is installed. In many cases, however, a portion of the surplus silage juice finds its way to and through the silo wall and runs down the outside.

Experimental Silo Studied

The Division of Agricultural Engineering, in cooperation with a stave silo manufacturer and a local dairy farm, has under observation a 14 x 45 foot silo built especially to study this drainage problem. The silo was built in June of 1940 and is now filled for the third time. The primary objectives of the experiment were to determine (1) the amount and rate of flow of juice to be expected under various conditions, (2) how the juice finds its way out of the silage mass, (3) the chemical composition and consequent losses of the juice drained off, and (4) a method of construction and drainage that will reduce as much as possible both the leakage through the silo walls and doors and the silage spoilage.

Considerable uncertainty still exists regarding the details of side-wall drainage, but for floor drainage the experimental silo has a reinforced concrete floor with both halves sloping toward the middle where there is a 4 x 4 inch trough extending the full diameter of the silo. As shown in the upper drawing of the accompanying figure, this trough is covered with concrete slabs, which are loosely fitted to permit the ready entrance of drainage juices, and whose tops are flush with the floor. The floor and the collecting drain of the experimental silo is covered with a 20-inch layer of coarse gravel (⅜ to 1½ inches) so that juice leaving the bottom of the silage mass at any point can travel freely to the drain. This floor drain has proven satisfactory, but there still is a question whether it might not be preferable to have a wooden grill, built in sections removable for cleaning the floor underneath. Regardless of construction details, any floor drain must extend entirely across the silo if it is to be effective.

The lower drawing in the figure shows another floor drain where six-sided tile are used for the collecting drain. Load-bearing hollow tile could be used if more readily available.

Three Years' Summary of Drainage Data*

Ensiled material		Drainage		Loss of nutrients	
Moisture	Weight	Silage juice	Rate of maximum flow	Digestible† protein	Minerals†
per cent	pounds	gals.	gals. per hr.	per cent	per cent
72	244,340	1,807	10	5.9	5.0
75	335,440	4,600	26	‡	‡
77	369,800	7,502	66	16.6	13.6

* For detailed report of the first year's data see "New Methods in the Drainage of Moisture from Farm Silos," C. K. Otis, Agricultural Engineering Journal; Volume 23, No. 10, October 1942.

† Chemical analyses of the silage juice were made by the Division of Biochemistry, University of Minnesota. Quantities in original crop were calculated from data given in F. B. Morrison's *Feeds and Feeding*.

‡ Analyses not completed.

Nutrients Lost in Drainage

Provisions were made at the experimental silo for collecting, measuring, and analyzing juices drained from the silage, as shown in the accompanying table. The volume of drainage showed a marked variation for the three fillings of alfalfa and increased with the increase in moisture content of the ensiled material. The maximum rate of flow was 6.6 times as great at 77 per cent moisture as at 72 per cent, although the total volume of the juice only increased 4.2 times.

Digestible-protein losses increased 2.8 times and the mineral loss increased 2.7 times for alfalfa with 77 per cent moisture when compared with losses from alfalfa containing 72 per cent moisture. Even though no definite drainage system is provided, these losses will take place by seepage into the soil and leakage through the silo wall when wet silage is put up. Drains can be effectively used to eliminate the disagreeable odor, unsightliness, and structural damage caused by leaky silos.

CUTOVER Forests Ask Only a Chance

JOHN H. ALLISON

MINNESOTA'S northeastern cutover region, ugly as it now seems, is in fact a sleeping beauty of enormous potentialities. Logging-scarred and fire-charred, she awaits only the magic touch of simple management which any land owner can apply, plus more adequite fire protection to awake and scatter her blessings over millions of acres. Apparently a complete wreck and often referred to as permanently ruined, she can, with very little assistance, support thousands of families and convert her vast environs into a prosperous and happy land.

A century ago these lands were covered by a magnificent forest, one of the most valuable in the world. On the sandier uplands the forest was composed of almost pure white or Norway pine. On the better soils hardwoods, mixed with white pine and sometimes spruce, made up the forest. The best white pine was found in these mixed stands. The greater part of the bog lands were covered with stands of spruce, highly valuable for paper pulp, and with tamarack and cedar. Logging operations, beginning about 1840 and reaching their peak of 2,300,000,000 feet board measure in 1899, have now almost completely swept over these lands. Present yearly volume is about 200,000,000 feet or about one-twelfth of peak production.

Our cutover forests can produce timber in abundance without sacrifice of scenic appeal.

Farm Settlement Lags

Seventy-five years of attempted agricultural settlement in this region has brought the clearing and improving of only about 1,650,000 acres, or 9 per cent, while about 15,500,000 acres, or 82 per cent of the total area, is still forest land. The remaining 9 per cent, about 1,700,000 acres, is within city and village boundaries, in highway and railroad rights of way, in waste land, and in industrial areas such as mines.

The original logging together with the fires that accompanied and followed it has left the greater part of the area covered with hazel or alder brush or with badly run-down forests in which the low-value popple (aspen) and birch predominate and in which there is very little of the high-value pine and spruce. But do not blame the logger too severely. Until rather recently most people in this region thought that all these lands would soon be cleared for farming and that burning would make them easier to clear. Hence, why protect them from fire? In fact, prior to 1920 it was the custom to burn over, every spring, the land logged during the previous fall and winter. As the consequence of all this, large areas of land which agriculture is not going to use for a long time to come have been converted into worthless hazel and alder brush. Moreover, there has been a great reduction in the density, quality, and value of the popple and birch which uncontrolled fire has caused to become dominant over other large areas of these lands. These same fires have almost completely eliminated the valuable white and Norway pine from the second-growth forest, although they did materially assist in the establishment of the second-growth jack pine stands now found on the sandy lands in the neighborhoods of Brainerd, Park Rapids, Bemidji, Cass Lake, and Willow River, and on the rock outcrop lands of northern St. Louis and Lake counties.

Most timber, both pines and hardwoods, 30 years or more of age survives the ordinary forest fire, but sustains some damage from even the lightest burns. Almost all pine and upland spruce under 20 years of age is killed by even light burns. Hence it is now realized that for the welfare of the region, it is very important to do everything possible to prevent and control forest fires.

Fire Control Encouraging

Forest fire control in this region was not seriously attempted until 1911 when the present Minnesota Forest Service was established, but so well has the program been developed that, since 1935, only about one-half of one per cent of the area protected has been burned over annually. This means that, on the average, any given area would be burned over only once in 200 years. Although weather conditions during the last eight years have been favorable for fire control, a careful study indicates that equally successful control during unfavorable years could be achieved by a 50 per cent increase in staff and equipment, an increase within the realm of early achievement.

Cutover forests now contain about 10 billion feet board measure in trees of sawlog size of which only about one and a half billion is pine. Probably not more than half the total timber of merchantable size can actually be logged commercially, the rest being in trees too widely scattered for profitable logging.

Annual growth now taking place in

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FEBRUARY 15, 1944

the cutover region totals about 475 million board feet, of which only about 175 million feet is pine, three-quarters jack pine. While the total growth considerably exceeds the current lumber cut, it only slightly exceeds the total drain, including other forest products such as pulpwood and fuelwood, plus losses from fire, insects, and the like. Pine and spruce are being cut considerably faster than their rate of growth.

Production Possibilities Enormous

At present, over 2,500,000 acres of former pine lands are occupied by brush or by popple and other northern hardwoods of quality too poor to produce either sawlogs or pulpwood. Converting these lands back into pine and giving them, together with the more than 1,500,000 acres already in pine, reasonable fire protection would enable us to increase the annual cut on these 4,000,000 acres to about 500 million board feet of Norway, white, and jack pine lumber plus about 300,000 cords of jack pine pulpwood. At the same time, concentrating the popple, the other northern hardwoods, the spruce, the tamarack, and the balsam on the soils especially suited to them and giving them similar protection from fire would enable us to increase the total annual lumber cut of all species within the cutover region to more than 600 million feet, plus about 750,000 cords of pulpwood, plus considerable quantities of mine timbers, hewed ties, piling, posts, and fuelwood.

The foregoing amounts are well within reasonable possibility. The 175,000 acres of United States owned forest land in the old part of the Chippewa National Forest, after 40 years of good fire protection, already is exceeding the rate suggested. These estimates are further supported by results obtained by the University's Division of Forestry on its 3,000-acre experiment station near Cloquet. After 35 years of good fire protection, the rate of growth of this forest, established almost entirely by natural processes, now is about double the per-acre volumes predicted above. But to obtain the rate of growth proposed for the cutover lands, the cutting of the young timber must be delayed until the popple and jack pine trees reach 40 to 60 years of age and other species reach 75 years or more.

Several important gains can be expected from the improvement of the forests of the cutover region. It would provide full-time employment for over 20,000 men as against 13,000 in recent years. The greater part of this increased employment would be distributed among many thousand part-time workers, mostly from the farms of the region. Less than half of these farms now have enough cropland to support their occupants who therefore must have either outside work or "relief." The increased employment from improved forests would materially reduce this region's relief load—a gain of no small importance both socially and financially.

The increased income which these forests can be made to yield to their owners, to loggers and mill operators, and to truck owners and railroads would materially increase the tax yield of the region, thereby further reducing the assistance now required from the rest of the state.

The increased production of lumber, pulpwood, and other forest products would reduce the quantity of such products which Minnesota and surrounding states will have to ship in from more distant parts of the United States or from Canada.

Recreational Uses Important

But the direct gains from forest improvement are not all. Recreation is an important source of income to the entire state as well as to the residents of the cutover region. Highways and lakes bordered by vigorously growing forests are much more attractive to tourists than burned-over lands covered with brush and briars and adorned with the skeletons of dead trees. Logging operations need not mar the lake shores or the road sides. Add soul-satisfying forests and tourists will come flocking back again and again to this land of beautiful lakes. Most certainly, the beauty of the cutover region, now sleeping, can be awakened and re-established for the use and enjoyment of man.

If seeing is believing, these photos prove that cutover forests come back strong when protected from fire. Left to right are young Norway pine reproduced on a clear-cut area; a 30-year jack pine stand nearly ready for pulpwood; and a reproduction of black spruce in a cutover swamp. Minnesota's vast cutover region still has over 15,000,000 acres of forest land.

TEXTILES Feel the Impact of War

ETHEL L. PHELPS

ALL OF US have been made aware of some of the effects of the war on textile products, but not all of us have experienced the same manifestations. Shortages in fabric and garment stocks and changes in quality of merchandise have varied from place to place. However, they are being met often enough so that many questions are asked. Why are denim work clothes for women or overalls for men so scarce? Why are children's snowsuits hard to find? Don't we have all the rayon we need? Why aren't there more low-priced dresses for women? Why is the quality of many fabrics and garments so poor? Will blended wool materials wear as well as all-wool fabrics? How can I select sheets that will give maximum service?

Answers to such questions are not simple because the whole business of making and distributing fabrics and clothing is extremely complicated, because war has disrupted many phases of this complicated industry, and because the situation changes rapidly. War has upset our supplies of textile raw materials; curtailed the manpower used in the manufacture of fabrics and clothing; cut off or limited the equipment needed for manufacture and restricted the type and quality of repairs needed to keep it operating. War has increased the income of many people, thus releasing many dormant or unsatisfied wants. Most important of all, war has created a gargantuan government demand for textile products for the armed forces, for lend-lease, for rehabilitation work abroad.

The employment of women in war plants has made it necessary to develop suitable work clothes for them. An enormous and increasing demand has arisen for these new-type garments, as well as an increased demand for men's work clothes and the cotton fabrics of which they are all made. In addition, cotton bagging and clothing fabrics needed for the army and navy are of a similar character and all such materials require the same type of equipment for manufacture. Some factory reconversions from osnaburg bagging back to denims have been ordered recently which in time may make possible increased stocks of civilian work clothes, provided the extra denim produced is not required for government uses.

At present the United States is making two thirds of the world's output of cotton goods. Nevertheless cotton goods production is decreasing, owing to causes too numerous to mention here. As a result our present production is 15 per cent below the 1942 high, while the army and navy have been finding new uses for cotton. According to trade reports, prospects are not promising for any early increase in cotton fabrics available for civilians. Thrift in use and meticulous maintenance will help extend the life of cotton fabrics and garments now in service. Such measures appear to be called for now in order to lessen civilian demand for cotton materials.

Wool materials are acutely needed for children's snowsuits, mackinaws, and utility or lumber jackets. However, the manufacture of this type of garment is said to be limited by shortages of linings and manpower as well as of wool material. It has been our good fortune to have been able to build up so great a stockpile of wool that nearly all restrictions on the manufacture of wool fabrics for civilians have been withdrawn and the whole wool-blending program terminated. Although wool was one of the first basic commodities to be controlled by a W.P.B. conservation order after Pearl Harbor, at the present time wool is relatively one of our more abundant fibers. Other restrictions aimed to conserve wool material in the manufacture of clothing still stand with certain exceptions, such as patch pockets which are now permitted in order to save rayon or cotton lining materials.

Two years ago it was assumed that rayon could be depended upon to replace other scarce or nonexistent fibers. Today high-tenacity rayon is being used for parachutes to drop materials such as cargoes, flares, and fragmentation bombs; for cord in synthetic rubber tires; for heavy duck used for powder bags; for parachute cords; and for many other essential purposes. Because of the rapidly increasing government demand for rayon, its availability for nonmilitary uses is shrinking, even though the total amount produced has been increased greatly. Civilians should conserve rayon wherever possible.

Department store buyers and consumers both report that inexpensive dresses are hard to find and may be made of very inferior material. Manufacturers of these so-called "low-end" dresses, those selling up to $5.00 retail, complain that they cannot get fabrics in sufficient amounts and at the necessary low price for their volume-price operations. Some explanations offered in this connection are that rayon fabrics formerly were underpriced to these dress manufacturers; that currently

A Wartime Textiles and Clothing Program for Civilians

- Buy nothing unless it is needed—help reduce consumer demand and avoid inflation.
- Plan for necessary buying thoughtfully—survey essential needs before buying.
- Study the textile materials offered for sale—look for useful information about fabrics and read labels.
- Select fabrics and garments for maximum service—for durability as well as for appearance.
- Sew at home if time and ability permit—home sewing affords a wider choice of fabrics, permits well-chosen and durable construction, and makes a contribution of labor and equipment.
- Wear garments suitable for the work to be done and avoid unnecessary damage.
- Keep fabrics clean and make repairs promptly.
- Provide suitable storage for both winter and summer clothing to protect it from damage of any kind.
- Wear clothing and use textiles as long as possible—make over garments when condition of cloth indicates additional service can be had from it.

materials are upgraded by extra finishing costs, such as screen printing used for short runs of figured rayon, and then sold for manufacture into higher-priced garments; that large increases in sales of rayons as yard goods to retailers have cut the supply available for dress manufacturers. Both consumers and dress manufacturers are buying on a "seller's" market.

Complaints of poor quality and high prices are being raised by many people. General reasons for the poor quality found both in ready-to-wear clothing and yard goods summarize some of the points already made. The supply of materials is limited; good quality materials go into higher-priced garments; the government is using tremendous amounts of high-grade materials of many types and the facilities for making them; manpower is scarce and expensive; every effort is made to achieve maximum production, even at the expense of quality. In addition strong consumer demand is another important factor, since many consumers appear eager to buy regardless of quality or serviceability.

In spite of problems of manufacture and quality, many high-grade materials have been available as a result of the large stocks customarily carried by merchants. Some are still being made in limited amounts. Trade papers claim that customers today buy better clothes because they have the money and recognize the higher quality of the merchandise. The Department of Commerce reports that for the first 9 months of 1943 retail stores' dollar sales were nearly 10 per cent ahead of those for 1942. This will be an all-time high in spite of shortages, and can serve as a measure of the force of the consumer demand for textiles, which is competing for nonmilitary stocks as well as rapidly depleting the reserve stocks which have been available so far.

Many blended fabrics now are offered for sale. Both garments and fabrics may carry labels indicating the percentage of wool, reprocessed wool, reused wool, and rayon or other fibers included in the material. Such labels are in accordance with the Wool Products Labeling Act of 1939, which went into effect July 14, 1941. Under provisions of this Act, wool means fiber which has never been woven or felted previously and also fiber remanufactured from yarns and clippings from knit goods which have not been used. Reprocessed wool means fiber recovered from woven or felted material which has not been worn. Reused wool means fiber remanufactured from any kind of product which has been used or worn. If other fibers, such as rayon or cotton, also are present, their percentages are to be given if they amount to more than 5 per cent. Since some reprocessed and reused wool may be as good as, or even better than, some grades of new wool, the presence of remanufactured wool, when indicated by the label, should not outweigh all other considerations in selecting a garment or fabric. Its use extends our supply of wool materials.

Other blended fabrics sometimes found on the market may be mixtures of rayon and casein fiber. Rayons are fibers which by chemical treatment are "regenerated" from solutions of cellulose. Casein fiber is regenerated from a solution of casein, the protein of milk. When the properties or characteristics of three such blended fabrics, all of them fine serges, were compared in a class study with similar properties for six wool French serges, some interesting differences were observed. The rayon-casein fiber blends as a group were a little thicker, heavier, and stronger than the wool fabrics as a group, but they were much less resistant to the wearing effect of abrasion. In the direction of the warp twice as much strength was lost with half as many rubs.

For many purposes where staple fabrics such as cotton sheets are selected for service and long wear, some indication of the characteristics of the fabric would make possible a wiser and more satisfying selection. A brand name does not facilitate the selection of the strongest of several choices if strength is thought to be important. Homemakers are not in a position to determine such differences experimentally at home. Information on the label, in addition to the brand name, which for bed sheets might give the weight of a square yard of the cloth, the percentage of sizing, the number of yarns in an inch both warpwise and fillingwise, and the breaking strength of the fabric, would give a better basis for selection than do appearance and feel alone.

When the war is over we are promised many new things in textiles as in other fields. Possibly other new fibers regenerated from natural sources will make a place for themselves, such as soybean fiber. Mixtures of solutions of cellulose and casein to make a combination rayon-casein fiber have been tried out. Synthetic fibers will be proposed for many purposes. One synthetic fiber, nylon, already has made a place for itself; others will follow. Laminated products, synthetic fabrics formed without spinning and weaving, finishing processes which modify, improve, and probably "make to order" certain fabric characteristics, are all in the picture.

However, before these can come, the war must be won, the needs of the armed forces must be met, after which civilians must be satisfied as well as may be. Conservation of materials, labor, machinery, and finished products is necessary. A textiles and clothing conservation program for civilians calls for reduced consumer demand combined with a thorough knowledge of textile materials on the market, thoughtful planning, intelligent buying, sewing at home when possible, and thrifty use of fabrics and garments.

In the textiles laboratory of the Home Economics Division, Miss Phelps uses a compressometer to measure thickness and resilience of a wool blanket. Here also are instruments for measuring strength, weight, and abrasive resistance of fabrics, and the size, strength, and twist of yarns.

HYBRID CORN — Its Origin and Value

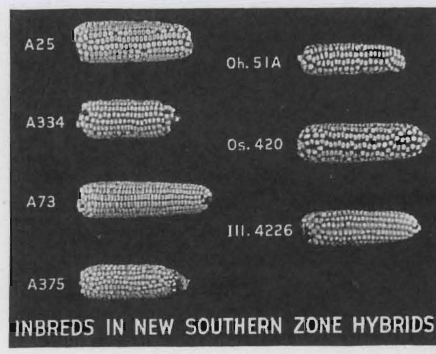
H. K. HAYES

NEARLY 50 MILLION acres of hybrid corn were grown in the United States in 1943, according to estimates of the Bureau of Agricultural Economics of the United States Department of Agriculture, approximately 52 per cent of the corn crop being planted to hybrid seed. The preliminary estimates indicate that 5,356,000 acres of corn were grown in Minnesota in 1943 of which about 88 per cent was hybrid.

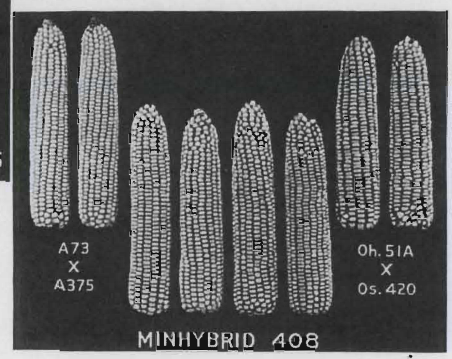
Data have been collected for many years in experimental plots comparing yields of Minhybrids, produced by experiment station breeders, with some of the better open-pollinated varieties. Increases for recommended hybrids in the Southern and South Central corn maturity zones over commercial varieties have ranged from 20 to nearly 40 per cent. The average of 20 per cent increase in yield for hybrid over open-pollinated varieties for the state seems very conservative. Thus Minnesota's approximate total yield for 1943 of slightly more than 200,000,000 bushels is about 35,000,000 larger than if hybrid had not been used. The only extra cost of this 35,000,000 bushels was the cost of seed and harvesting, certainly not more than 8 million dollars at present prices. Without this increased production the food and feed shortages would be even more acute.

Because of the great value of hybrid corn it may be of interest to give some idea of the basic research that was necessary to produce desirable hybrids for most of the more important corn growing regions of the corn belt. Further improvements are possible in all hybrids now available and it is reasonable to conclude that eventually nearly 100 per cent of all corn grown in the United States will be hybrid.

The corn breeder's task is to obtain desirable parents and make available satisfactory crosses of known performance for each important corn-growing region. Each plant in a good hybrid has excellent heredity. The parents used for the cross have been bred for ability to withstand lodging, for resistance to ear-, stalk-, and root-rotting diseases and smut; for desirable plant, ear, and kernel types; and for adaptability to a particular corn-growing region. In Minnesota this refers to one of five maturity zones ranging from a longer growing season in the Southern zone to a much shorter one in the Northern. The standing ability of a good hybrid is one of its most notable and valuable characteristics and in this respect hybrid corn is far superior to the former varieties grown.



Inbreds (left) and single crosses (below) used in the new Minhybrid 408. The single cross labels indicate which four of the seven inbreds shown occur in this particular hybrid.



Hybrid corn was obtained only as the end result of extensive, far-reaching studies in corn genetics and breeding, only a few of which are mentioned here. The original researches were started by E. M. East at the Connecticut Agricultural Experiment Station and G. H. Shull at Cold Spring Harbor in 1905. The present writer was East's assistant in 1909. A statement of East's made that year still lingers in my memory. He said, "I started a study of the effects of self- and cross-fertilization in corn with the firm conviction that such knowledge was necessary in order to develop a logical method of corn breeding." East had attempted to obtain improved varieties of corn by selection under open-pollinated conditions and with the varieties available had learned that progress was rather slow, owing chiefly, he thought, to the lack of control of the source of pollen, that is, the male parent. In 1910 when hybrids were being grown by the writer at the Connecticut station, East expressed the viewpoint that if these were grown at a corn belt station they would create a sensation because the crosses were so uniform and very vigorous. The same year a great botanist told the writer that he did not believe corn could be continually self pollinated without gradually becoming so weak that it could no longer be propagated. Had this been true it might well have doomed to failure any attempt to improve corn by producing inbred lines and using hybrids for the commercial crop. Fortunately, later results proved that he was wrong.

Shull isolated inbred lines and studied first generation crosses between them independently of East's studies although each of these two workers was familiar with the other's researches. Some crosses of Shull's between inbred lines yielded much more than normal corn, others less. In 1910 Shull concluded that first generation crosses eventually would be used by the corn grower.

All workers, however, recognized the difficulty that the yield of inbred lines available at that time was so low that the cost of hybrid seed would be almost prohibitive. Then, in 1917, D. F. Jones at the Connecticut Agricultural Experiment Station presented the double-cross plan which is the chief method now used with field corn. Inbred lines are isolated by selection from open-pollinated varieties or from crosses between inbreds, each of which has certain desired characters. A single cross is produced by crossing two inbred lines. The double cross is produced by crossing two single crosses as is illustrated for the four inbreds, A, B, C, and D.

Inbred lines	A B	C D
Single crosses	A x B	C x D
Double cross	(A x B) (C x D)	

The advantages of this method are now widely appreciated by seed growers. Only a small amount of single-crossed seed is needed to plant the crossing plots. A single acre utilized for producing double-crossed seed produces enough seed for from 250 to 500 acres of commercial corn. Properly selected double crosses yield about as well as crosses between inbred lines. Hybrid corn utilizes hybrid vigor which is present only to the greatest extent in a cross between parents each having desirable inheritance and combining well together.

Space is available only for two illustrations of the application of research studies to corn improvement. In Minnesota, corn smut is a serious disease, most of the hybrids grown being much more resistant to smut than normal varieties. An exact knowledge of losses from smut was not available. Extensive studies by plant pathologists and plant breeders in Minnesota, using hundreds of paired comparisons of plants infected and not infected by smut, have been made, and it is now known that smut causes great reductions in grain yields. It is apparent that an ear heavily infected by smut may be worthless but it was a great surprise to learn that a smut gall on the neck of the plant above the upper leaf caused a much greater reduction in grain yield than any other infection except ear smut, frequently resulting in no ear being formed on the plant. The mode of inheritance of smut reaction has been learned by intensive correlated study of the mechanism responsible for the transmission of inherited factors from one generation to the next, called the chromosome basis of heredity, and the smut reaction of crosses between resistant and susceptible inbred lines. Of great immediate practical value was the knowledge that inbred lines or hybrids of corn that were resistant to local collections of smut proved resistant also to a mixture of smut from various regions of the corn belt. Most of the present corn hybrids are more resistant to smut than normal varieties, and the hybrids of the future may be expected to be more resistant to smut and other diseases than those available today.

The breeder produces improved inbred lines of corn in the same manner that the breeder of wheat obtains improved varieties by crossing and selection, except in corn there is the necessity of controlled self pollination during the selection process. Wheat is naturally self pollinated. It is possible to build up improved lines in corn by planned crosses, using parents that contain together the desired characters, and practicing selection in self-pollinated lines. Many of the inbreds used in hybrids produced by the Minnesota Agricultural Experiment Station were selected from the progeny of crosses between inbreds and at least one of the inbred parents was selected for ability to withstand lodging. No inbred lines of corn yield as well as hybrids, although those available today are much better because of their breeding than the inbred lines originally produced by East and Shull.

After obtaining inbreds they must be tested in crosses for yield and other characters. This testing problem has been greatly simplified by the discovery that the yield and time of maturity of double crosses can be predicted with great accuracy from data on the performance of the appropriate single crosses. The method used was one of several plans suggested by M. T. Jenkins of the U. S. Department of Agriculture in 1934. It is impossible in a short article to present data to prove the accuracy of the method. The proof of the reliability of the method was obtained, however, by extensive comparisons of the performance of a rather large number of actual double crosses, with their predicted yield. The comparative ease of prediction of a large number of double crosses may be appreciated from the following example. Having available 20, or n, inbred lines the greatest possible number of single crosses that can be made are 1/2(n)(n-1), or 190. These 190 single crosses are tested in yield trials in several locations and with sufficient replications to obtain sufficiently accurate data, whereas it would be clearly impossible to test all of the double crosses. The number of different double crosses that can be made with these 20 inbred lines are 3n(n-1) (n-2) (n-3)/24 or 14,535.

Table 1. Average yields and moisture content at husking of the six possible single crosses between four inbred lines, A375, A73, selected in Minnesota, Os. 420 from Iowa, and Oh. 51A from Ohio, when tested in several locations in 1940 and 1941

Cross	Yield, bu. per acre	Moisture per cent at husking
A375 x A73	71.0	23.9
A375 x Os. 420	81.4	25.6
A375 x Oh. 51A	73.1	21.8
A73 x Os. 420	88.3	26.9
A73 x Oh. 51A	81.3	22.2
Os. 420 x Oh. 51A	78.2	26.2

Table 2. Prediction of the performance of Minhybrid 408 from the yields of single crosses. Minhybrid 408 (A375 x A73) (Os. 420 x Oh. 51A)

Cross	Yield, bu. per acre	Moisture per cent at husking
A375 x Os. 420	81.4	25.6
A375 x Oh. 51A	73.1	21.8
A73 x Os. 420	88.3	26.9
A73 x Oh. 51A	81.3	22.2
Predicted yield of Minhybrid 408 = Average	81.0	24.1

Tables 1 and 2 illustrate the method of prediction for one double cross that was approved for release last winter as Minhybrid 408, ears of which are illustrated in the photographs.

From four inbreds, for example, A, B, C, and D, three different double crosses can be made—(AxB) (CxD),

(Concluded on Page 7)

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