height and tillering of the plant. The weight of the average kernel increases quite uniformly with the yield per head.

It is quite evident from these tables that the number of heads on a plant is more important in determining its productiveness than is the size of the heads, and that, although the kernels are larger on plants having large heads, they are not necessarily so on plants producing the greatest weight of grain.

PLANT ADAPTATION.

By A. M. TEN EYCK, *Professor of Agriculture, State Agricultural College, Manhattan, Kansas.*

That the varieties of domesticated plants under cultivation vary in productiveness, quality and hardiness in different soils and climates is a fact well authenticated but not fully understood. In the annual convention of the American Agricultural Colleges and Experiment Stations, in 1890, Prof. W. J. Green, of the Ohio experiment station in discussing the subject of variety testing, stated that as a general rule it is true that varieties of fruit which proved best in one State proved best in all other States having the same latitude and similar climatic conditions. He did not consider the difference in location or soil to be prominent factors in determining the value of a variety for any particular locality. Apparently the adaptation of plants is more influenced by climatic conditions than by soil conditions, although doubtless both have their effect on the plants in determining the adaptation of a certain variety for a certain locality. However, I have observed, in studying variety testing of several crops at different experiment stations, that the best producing varieties of corn and other grains at one station are often found to be among the best producers at other stations, although often the climate and soil conditions are not entirely similar. Evidently there is a great deal in breeding, and in the hereditary power of a well-bred plant to transmit its qualities to its descendants under varying conditions. However, we learn from the origin and development of plant varieties that a variety of fruit or any other plant should not do equally well everywhere and why it should not.

Out of 270 species of cultivated plants, M. De Candolle has succeeded in finding the wild forms of 193 species. Of the remainder, 27 he considers doubtful as half-wild, and the rest he has not yet been able to find in the wild state. Darwin holds that in such cases the cultivated plant has either changed so much that its wild prototype can no longer be recognized, or that its original form has ceased to exist. From a single comparatively valueless, primitive, wild form have originated in the course of time thousands of valuable varieties of plants, all differing from the original, and some to such an extent that they cannot be recognized.

As an example of variation from one type, take the cabbage. The wild plant resembling kale grows native along the shores of the Mediterranean. From it we have the many types and varieties of kales and collards, the Brussels Sprouts or bud-bearing cabbages, the cauliflower a variation of the above in which the many buds are all gathered into one compact head, and the single head cabbages, varying greatly in size, shape and color. Corn or maize has varied in an extraordinary and conspicuous manner. The different races vary in height from 15 or 18 feet down to only 16 or 18 inches. The size of the ear and its seeds vary in like manner, and the ripening season varies from six or seven months in southern latitudes to three or four in colder climates. We might also consider the thousands of varieties of flowering and foliage plants—roses, pansies, coleus—and of fruit plants—strawberries, apples and cherries. These examples will serve in some degree to illustrate the great amount of variation in plant varieties.

It is not my purpose here to enter into any discussion as to the causes of these wonderful changes and variations which have occurred in some races of plants. It is self-evident that the characters of plants are hereditary and are transmitted to their descendants, but in addition to inherited properties it is also observed that new characters may appear in some descendants of a plant, characters which were not possessed by the parent plant, or at least not in a noticeable degree and it is this tendency to vary, which seems to be common in all plants, that has resulted in the existence of so many varieties. Illustrating the tendency to variation which may be found among individual plants of the same variety of wheat, I quote from Prof. W. M. Hays' Minnesota experiment station Bulletin No. 62:

"Among the 400 plants of McKendry's Fife, for example, plants were found which matured in ninety-seven days, others requiring one hundred twenty-seven days. Among Power's Fife plants the range was from ninety-eight to one hundred twenty-two days; and among Haynes' Blue-Stem plants, the range was from ninety-nine to one hundred twenty-eight days.

The 10 plants which appeared to be the best yielding plants out of the 400 of each variety were harvested and notes taken as to height of plant, number of spikes, length of spikes, and yield of shelled grain. The following table shows the extremes of the variation in each case.

Variation among best 10 out of 400 wheat plants.

Name of Variety.	Height of stalk.	Length of spikes.	Number of spikes.	Yield.
	<i>Inches.</i>	<i>Inches.</i>		<i>Grams.</i>
Haynes' Blue-stem	31—39	4—4½	19—31	15.4—19.4
Power's Fife	27—33	3½—4	18—33	3.4—13.8
McKendry's Fife	30—33	3½—4	22—33	6.8—16.7

Similar observations have been made in the breeding of corn by Prof. P. G. Holden, of Iowa. The plants from individual ears varied greatly in leafiness and in size and height of stalks, in the height of ears on the stalks, and in the maturing of the corn, while the yield of corn

from rows which were planted with seed from different ears of the same variety or breed varied more than 150 per cent. At this station similar results were observed in our ear tests during the seasons of 1903 and 1904. The choice selected ears from Reid's Yellow Dent seed-corn, which was selected for uniformity and trueness to breed characteristics, showed as much difference in the characters of plants on different rows as might be observed between different varieties of corn, and in 1903 a difference of nearly 400 per cent in yield was produced by the same area of land planted with seed from individual ears. In 1904 the greatest range in yield with selected ears of this variety was only a little over 80 per cent, and in 1903 the greatest variation in yield was only sixty per cent.

Plants vary along certain lines. Cultivated plants have varied in the line of their use. The numerous varieties of fruit trees of the same genus differ very little, in general, in their roots, leaves, flowers and stems, but to an extraordinary extent in the size, shape, color, taste, period of maturity and keeping properties of their fruits. In garden flowering plants, on the other hand, the flowers differ much in size, shape, color and odor, but the seeds are very much alike. We cultivate the fruit tree for its fruit, the flowering plant for its flowers, *i. e.*, for particular characters; and if these characters vary, or are more strongly displayed in descendants, the plants are propagated and the variation is preserved. Other characters of the plant also vary, but the variations are disregarded because of no use to man, and so we find variation in one character prominent.

Selection is the process by which new varieties are fixed. Artificial crossing may be used to induce variation, with a view to promoting the development of new forms, but selection is always the final process by which new varieties are established and maintained.

Darwin has shown that wild plants vary along certain lines. In their "struggle for existence" only those individuals are able to maintain themselves which are best able to resist the prejudicial influences to which they are exposed, that is, those best suited to surrounding conditions, and only such varieties will reproduce themselves and further develop their special properties. Varieties and species which are not endowed with qualities to endure the struggle for existence perish. As the cultivator develops that which is best suited to his own purpose, so in the struggle for existence only those varieties survive and reproduce their kind which are better adapted through some property they possess to endure the struggle.

By this natural selection, plants become even better adapted for the purposes of self-preservation than cultivated plants are for the purposes of man. Our noxious weeds will serve as an example. Not only do they vigorously sustain themselves in competition with other plants, but it requires the united efforts of men, supported by a weed law, to keep them within bounds. Every wild plant is very accurately adapted to the conditions and circumstances in which it grows and is reproduced. Its organs have the shape, size, mode of development, power of movement, etc., needful for this purpose; if they did not, the plant would inevitably perish in the struggle for existence.

Three principal factors largely determine the value of a variety of any cultivated crop, namely, yield, quality and adaptation, and the last named is really the deciding factor which determines whether a variety may be successfully grown in any locality. We have learned that plants vary in all their characters, but that in the case of cultivated plants only the varieties are preserved which are of use to man, in the wild state only those which are in harmony with the environment or the surrounding conditions. In no two countries, perhaps in no two sections of the same country or State, are the plants subject to exactly the same conditions of soil and climate. One section may have a slightly different soil, a little more dry weather, and the plants of this section may vary to adapt themselves to these conditions. If the plant is removed from its native habitat, and planted in a different part of the world or country, in a different soil, surrounded by different conditions to those to which it had been accustomed, it is placed at a disadvantage; it is exposed to a new environment to which it is not suited. Thus we can understand why a good variety of fruit or grain does not always give as good results in all places, and we should expect a variety originating from the plants of a certain region to be best adapted for growing in that region. Or such plants may be adapted for growing in any region having similar conditions of soil and climate. We find a demonstration of this principle in the fact that wheat and other grains, brought from the steppes of Russia and Turkey, are well adapted for growing in the western plains region of the United States, which has a climate and soil very similar to that of the countries named. The Turkey Red wheat, for instance, has largely replaced all other varieties of winter wheat grown in the West, because of its greater hardiness and productiveness, and yet some of the varieties which it has succeeded had been grown in the West for many years and seemed to be fairly well adapted to western climatic and soil conditions. This superior hardiness and adaptation which the Russian and Turkey varieties of grain appear to have in our western country may be largely credited to the centuries of training which these varieties have had in an environment almost identical with that of similar latitudes in the West, while the varieties which the Russian grains succeeded, are, as a rule, those which have been gradually moved from the Eastern and Middle States farther west; and although many of these varieties have gradually become more or less hardy and fairly well adapted for growing in our western climate, yet, in the comparatively short period during which they have been grown under western conditions, apparently they have not become so hardy and well adapted to those conditions as the Russian and Turkey varieties.

We have growing throughout the West a large number of grasses and native grains which are fully hardy and perfectly adapted to the conditions under which they grow, and we have neglected to a large extent to develop these native grasses and grains. One of the urgent needs of western agriculture today is for domestic grasses which can be successfully and profitably grown for pasture and meadow and in rotation with other crops. Previous to the introduction of *Bromus inermis* there was practically no domestic grass which could be grown

successfully throughout the central and western portions of Kansas; even this grass is not fully adapted, especially for the extreme western and southern parts of the State; also, in some soils it does not seem to thrive well. We ought to develop domestic grasses from our native grasses. These wild grasses are just as capable of producing valuable cultivated varieties as were the wild prototypes of many of the valuable domestic grains and grasses which we are growing today. This work is being undertaken at the Kansas experiment station, and although little has been accomplished thus far, the work is of the greatest importance, and it is to be hoped that in time valuable varieties of cultivated native grasses will be developed.

Probably more has been done along the line of developing the wild fruits of the United States than with any other class of native plants, and yet improvement in this line has been slow and costly. In speaking on this subject, Prof. N. E. Hansen, of South Dakota, the noted fruit breeder of the Northwest, says: "It has cost considerably over one million dollars to determine that the apples commonly grown in the Eastern and Southern States, which came originally from western Europe, cannot be successfully grown over a large portion of the northern Mississippi valley, and many thousands of dollars are being spent annually in every State of this vast region in order to demonstrate this fact still further." Professor Hansen's plan is to develop the native fruits, either by selection or by crossing the best native varieties with the cultivated varieties, the aim being to combine the hardiness of the wild fruits with the size and quality of the cultivated varieties. Professor Hansen has accomplished some wonderful results with cherries, plums and small fruits; and, largely through his efforts, directly or indirectly, the Northwest is today supplied with many native cultivated varieties of fruits which are not only productive and of good quality but are perfectly hardy in the conditions and climate in which they grow.

I quote some of the ideas and facts from Professor Hansen, in the bulletins of the South Dakota experiment station, as follows:

The wild fruits are already superior in hardiness, as summers and winters of many centuries have acclimated them, and weeded out individuals of insufficient vigor. . . . We must create a new pomology. About all the varieties familiar to eastern fruit growers are tender and worthless on the open prairies of a large part of the Dakotas, Minnesota, northern Iowa, and the Canadian northwest. . . . Plants from a comparatively mild, moist coast climate are not adapted to a dry continental climate. Man readily adapts himself to such environments and finds the climate salubrious, but plants have no power to provide against such changes. Plants from the drier, interior northern portions of Europe and Asia prove hardy in South Dakota. . . . Many plants cannot adapt themselves to a change in location nor to cultivation in open exposure. Some hardy, native plants, which flourish in sheltered places or on moist land, fail on dry upland. Some plants are strong and aggressive, while others are retiring and dependent. . . . It is now a well-established fact that a species of plant extending over a wide geographical range varies greatly in ability to resist cold. Southern box-elders winter-kill in Manitoba; box-elders from Virginia winter-kill in Iowa; box-elders from Kansas kill to the ground at this station; yet in each case the local native box-elder is perfectly hardy. . . . Dakota planters should make sure that their ash, box-elder, elm, and other trees native to the State are not grown from seed picked too far south. Conversely, it is not best for southern planters to get seed from too

far north because the term "*hardiness*" implies ability to *resist heat* as well as cold. . . . This variation in hardiness points to a slow process of acclimatization by nature.

De Candolle writes in "The Origin of Cultivated Plants:" "The northern limits of wild species . . . have not changed within historic times, although the seeds are carried frequently and continually to the north of each limit. Periods of more than four or five thousand years, or changements of form and duration, are needed apparently to produce a modification in a plant which will allow it to support a greater degree of cold." We should take full advantage of this great work done for us by nature in acclimating plants, and cultivate our local form of the native species instead of the form adapted in the course of thousands of years to a mild, moist climate. This fundamental thought—to work with, and not against nature in the adapting of plants to our prairie climate—underlies all efforts in the improvement of plants

Hardiness requires fixed characters in the plant, and this is exhibited by wild plants which, being perfectly adapted to certain environments, change very slightly, if at all, even during the lapse of centuries. These wild plants when grown under cultivation are surrounded by new conditions, which cause them to vary in their characters, and it is true of our cultivated varieties that under the various conditions in which they are grown there is much greater tendency to variation in the characters of the plants than is found in the wild plants of the same species. From the experiments of breeders and from general farming experience it would appear that changes in quality, productiveness and other minor characters of plants occur much more readily than changes which tend to produce hardiness or better adaptation to new or unsuitable environments. The changes by which plants become more hardy and more resistant to unfavorable conditions doubtless take place very slowly, yet with annual crops, especially those which are produced from seed, changes by which the plant becomes better adapted to the conditions in which it grows evidently take place much more rapidly than with wild plants. Not only do we have the general experience in western agriculture to prove this proposition, but the experiments which have been carried on in different states in changing seed and testing varieties prove not only that seed grown in different localities is better adapted for growing under certain conditions than other seed, but also that varieties become gradually more productive and more vigorous and hardy as they are grown in a certain climate and soil.

As reported in Bulletin No. 39 of the North Dakota experiment station, it was found, in exchanging seed wheat with the Minnesota experiment station, that when the new seed was simply the old variety, the home-grown seed proved to be superior in yield. As an average of many tests, the home-grown seed yielded 3.4 bushels more wheat per acre than the seed of the same varieties brought directly from Minnesota. However, it was observed, when several varieties of Professor Hays' selected wheats were introduced and grown at the North Dakota experiment station, that these varieties gave larger yields than the best home-grown seed of the old varieties. Again, when the selected wheats had been grown a few years at the Dakota station, and new seed of the same varieties was again introduced from the Minnesota station, the older seed of the improved

varieties proved to be the better yielder by several bushels per acre, indicating that in the interval of two or three years the selected wheats had become better adapted for growing at the North Dakota station than the same variety of seed from the original source.

At the Nebraska station, as reported in Bulletin No. 72, it was found in testing the adaptation of varieties of winter wheat during a period of five years that a certain few varieties were much hardier and much better adapted for growing than others. "Samples of wheat of the same variety, but grown in different parts of the country, when grown side by side showed much difference in their habits of growth, which were greatly to the disadvantage of the seed grown east of the Missouri River." It was noted, also, that there was a tendency on the part of the alien wheats to adapt themselves to the local conditions when grown at the station for a number of years. "Kansas-grown seed matured earlier and yielded better, but entirely winter-killed, when the Nebraska and Iowa-grown seed passed the winter successfully."

It does not always follow, however, that home-grown seed of certain crops is better adapted for growing in a certain climate and soil than imported seed. At the Alabama experiment station, as reported in Bulletin No. 111, in a five-years trial in exchanging seed corn, it was observed that the seed corn from Illinois gave slightly larger yields than the seed from the Gulf States region, while more satisfactory yields were obtained with the seed from both the North and the South than from the home-grown seed of the same variety. "Late varieties from the North made good yields at Auburn, but the smallest yields were made from early varieties of northern origin." Also in Colorado, as reported in Bulletin No. 57, the results of experiments in testing seed corn from different altitudes and latitudes were not all uniform. The eastern-grown seed from Massachusetts, Pennsylvania and New York, on the whole gave better yields than seed grown west of the Mississippi River. The northern-grown seed gave less yields than home-grown seed for the Pride of the North and much better than the home-grown seed for the Leaming variety. Excepting the seed from the Eastern States it would appear that the difference in seed was largely a matter of adaptation of variety and that the Pride of the North was a variety well adapted for growing at the Colorado station.

Many farmers have made it a practice to change seed of wheat and other crops occasionally, claiming that when they grow the same seed for a long period it runs out and becomes less hardy and productive than it was when first introduced. If a crop is not adapted for growing in a certain region, doubtless there is an advantage in getting new seed occasionally from the sources where the crop grows to perfection, but if a crop is adapted to a certain climate and soil, or has become adapted by a long period of planting and selection, nothing would be gained and much might be lost by introducing new seed of the same variety from the original source. If a better variety from a better strain of the same variety was obtained, there might be some advantage in changing seed, as was shown by the experiments at the

North Dakota experiment station, when Professor Hays' selected wheats proved superior to the best home-grown seed of the old varieties. Kansas is well adapted for growing corn and wheat, and it is a question whether any advantage may be gained by changing seed with another State, unless the new seed is a better bred or improved variety; but with oats it may be different. Apparently, oats are not well adapted for growing under Kansas conditions, and until we secure hardier and better adapted varieties it is probably advantageous and necessary to introduce new seed of oats from those States where oats grow to greater perfection than in Kansas. The same may be said also of potatoes, although the tuber is not really a seed, yet perhaps the same principle applies with potatoes as with oats.

VARIETY TESTING.

Although a large amount of variety testing has been carried on at the experiment stations throughout the United States, yet apparently little has been accomplished towards the permanent improvement of crops by mere variety testing. The methods employed by most of the stations have simply been the testing in a small way of a large number of varieties. This has usually been continued only a few years at a time, when by a change of men or reorganization of the work the variety testing has been dropped for a time and the seed lost, so that the varieties have often entirely disappeared and in some states ten years after the issuing of a bulletin giving results of variety tests, the station will be testing an entirely different and new lot of varieties. In order that the testing of varieties by the experiment stations may become of permanent value and use to the farmers, seed selection must go on with the variety testing. The best selected varieties should be planted in "increase plots," and the seed thus secured should be distributed among the most enterprising farmers of the State, who may be induced to purchase such seed at a fair price, and should be encouraged to engage in growing the seed for further sale and distribution among their neighbors. By combining breeding and selection with variety testing and distributing the seeds of the best producing varieties among the farmers, a vast amount of good may be accomplished. Instead of simply getting a record of what certain varieties will produce and then dropping them, the propagation and distribution of the best producing varieties by some such method as suggested above will cause these improved varieties to be widely grown, and a few years' work along this line by the experiment station of any State should result in the introduction and cultivation in each State of the "best" varieties which will greatly improve the average yield of standard crops, and eventually add greatly to the material welfare and prosperity of the State.

In studying the reports of the variety trials of the several standard crops at the experiment stations in different States, to one who is unacquainted with the work of variety testing, the first surprise is the vast number of varieties which are grown, and the few of the same name that are grown throughout any large area, and an even

greater surprise is the great variation in the productiveness, quality and hardiness which is observed between different varieties. Only a few of all the varieties tested at the different stations prove to be superior in all the qualities which make a certain variety more valuable than others. For instance, after five years' (1897-1901) testing of wheat at the Nebraska station as published in Bulletin No. 72, of the 118 varieties grown only 2, Turkish Red and Big Frame, were found to have sufficient hardiness and productiveness to be recommended for general growing in that State. At the Kansas station, as reported in Bulletin No. 71, out of some 50 leading varieties which had been grown at the station for several years only 3, the Turkey, Tasmanian Red, and Crimean, withstood the winter of 1896-97 sufficiently well to yield at the rate of 10 bushels or more per acre. In the two tests noted it will be observed that the want of hardiness or adaptation was the principal factor in determining which was the "best" variety. In 1903, 79 varieties of corn were grown in our variety test at this station, and the yields of what were considered as "standard" varieties, varied from less than 30 to more than 89 bushels per acre. In a test of 20 varieties of oats, the yields ranged from 19 to 53 bushels per acre, and among 12 varieties of barley there was a range in yield of from 17 to 33 bushels per acre. These tests were repeated in 1904 and 1905 with similar results, although the range of difference in yields was not so great as in 1903.

When we observe this great variation in productiveness and hardiness of different varieties grown under similar or practically the same conditions of soil and climate, we must admit that there is a great difference in varieties, and that some varieties may be grown by the farmers at a much greater profit than others. It is certainly to the interest of the farmers to secure and grow these "best" varieties, and it is the plan of the Kansas station to propagate and distribute some selected seed of all the best producing varieties of standard crops as shown by the testing at this station; in fact, we are already engaging in this work. During the past two years the Agricultural Division of the station has sold and distributed among the farmers of Kansas some four hundred bushels of selected seed corn. We are also distributing seed of the best varieties of wheat, oats, barley, emmer, cowpeas, soy beans and Kafir corn.

The question arises as to how widely these "best" varieties may be adapted for growing. Will the corn which produced well at the Kansas station produce well all over the State, wherever corn is successfully grown? From a study of variety testing at the experiment stations it is evident that some few varieties of wheat and corn have proved to be among the best producers through a wide area of country. The Fultz wheat, for instance, which is one of the best producing varieties of the soft red type of wheat at the Kansas station, is also one of the best producers at the Kentucky and Tennessee stations and has a wide adaptation. Likewise, the Reid's Yellow Dent corn, which originated in Illinois, is now being grown successfully in Iowa, Nebraska, Kansas and Missouri. Although as stated, some varieties are grown successfully throughout a large area of country in different

soils and even under somewhat different climatic conditions, yet even the "best" varieties are not fully adapted to the new conditions and gradually become better adapted, as shown by the experiments in changing seed wheat at the North Dakota experiment station, and by many similar trials at other experiment stations.

It would be interesting to know just how these "best" varieties have originated and why they are superior to others in their class. Some, like the Turkey wheat and Russian varieties of grain, are evidently "best" largely because of their greater hardiness or power to resist the adverse climatic and soil conditions, which character they have acquired by centuries of adaptation in a similar climate and soil. Some varieties (and this may be more general than can be proven) are "best" because they are better bred. The record of the origin of some of the "best" varieties has been kept. With wheat, for instance, several of the leading varieties, such as the Fultz, White Clawson and Blue-stem, according to Prof. Andrew M. Soule, of the Virginia experiment station, have been originated by "picking out what are apparently spotting heads of wheat from large fields and 'roguing' them until a distinct character of head and grain has been secured." The Power's Fife wheat, for many years one of the best producing varieties of Scotch Fife wheat grown in North Dakota, originated from a single plant which was found growing in the edge of an oat field. Of the 6 improved varieties which were originated by Professor Hays, at the Minnesota experiment station, 4, including the 3 best producers, came from selected individual parent plants, and were produced by continued plant selection lasting for several years. The others were in-bred crosses, namely, 2 selected plants of the same variety were crossed, and from the plants produced, from these crosses the best individual plants were selected for a number of years, finally establishing the improved variety. Thus these varieties have been established by what is really a type of intensive inbreeding, which has largely destroyed the tendency to variation in the plants and fixed very strongly their type and character, so that it is uniformly produced even under changed environments. A good variety of any crop from this standpoint is largely due to the prepotency of plants which have the hereditary power to reproduce their characters, and such varieties will produce well wherever the climatic conditions will allow the plants to grow and mature.

Although these well-bred varieties may have a wide distribution, yet improved varieties may be developed locally which are superior to the best introduced varieties. The place to breed drought-resistant crops, for instance, is in the region where they must grow, and this principle is more or less applicable to the breeding of plants in any locality.

I believe in the local testing and breeding of crops. The proposition to use the county poor-farms as sub-experiment stations is a good one. By making use of the county poor-farms in different parts of the State for testing of varieties and the selection and breeding of those varieties found best adapted for growing in that district, we would soon be able to produce and distribute to farmers of that

section varieties which are better bred and superior producers to those which the farmers are at present growing. There are many local differences of soil and climate which require crops especially adapted for those conditions, and there is little question but that there are some varieties which are better adapted for growing on certain kinds of soil than others. It was found by experiment at the Tennessee experiment station, as reported in Bulletin No. 2, Vol. XVII, that the Hickory King corn was better adapted for growing on upland than Cocke Prolific, while on the bottom-land and on fertile soil generally, Cocke Prolific was by far the better producer. Again, in testing the different varieties on manured and unmanured land it was found that, while Cocke Prolific responded well to manuring and gave largely increased yields, the Hickory King received comparatively little benefit from the application of manure. At this station, in 1903, the Iowa Gold Mine corn proved to be an inferior yielder in the regular variety trial on heavily manured land, but on a poor piece of upland, on another portion of the farm, the Gold Mine proved to be the best producer out of 12 varieties, 11 of which gave larger yields than the Gold Mine on the fertilized land.

It is also a well established fact that certain grasses and grains are well adapted for upland or light soils, while others are better adapted for bottom lands and on the more fertile or better watered soils. In order to obtain varieties adapted for all sections of the State, it may not be necessary to originate new varieties. On the other hand, I should prefer to reduce the number of varieties of the different crops which are at present cultivated, and by selecting a few of the best varieties, and growing and breeding them locally, a local adaptation may be effected by which the seed of a certain variety may become superior for planting in a certain part of the country. It will not be necessary to have a different name for the corn of each section. Reid's Yellow Dent, for instance, may perhaps be bred and adapted for growing successfully throughout the whole corn-growing area of Kansas. The corn would be Reid's Yellow Dent wherever grown, but each section of the State would have its particular strain of seed, differing little if any in type from corn grown in other sections of the State, but differing much perhaps in adaptation to a certain environment.

THE USE OF THE SEED PLAT IN THE PREVENTION OF DISEASES IN WHEAT.

By E. M. FREEMAN, *U. S. Dept. of Agriculture, Washington, D. C.*

IMPORTANT FUNGUS DISEASES.

The most important diseases of cereal crops are caused by fungi of the smut and rust groups. Of the smuts there are two well known forms, namely, bunt or stinking smut, and loose smut. It has been known for some years that the bunt can be prevented by seed treat-