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OF THE CASTOR PLANT.

W. R. SHAW.

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THE IMPROVEMENT OF THE CASTOR PLANT.

W. R. SHAW.

The castor plant is cultivated as a field crop, solely for the oil which is produced in the seeds, which are commonly called castor "beans". The percentage of this oil in the seeds varies, and the report is current, and supported by all the evidence, that the average percentage of oil in seed produced in Oklahoma is much less than the same average in seed produced in regions further north and further east. This difference in favor of the product of other districts may be partly ascribed to general lack of adaptation of the castor plant to Oklahoma conditions, but it is probably mostly, if not entirely, due to the lack of selection of varieties of the plant specially adapted to the production of a high grade of seed under Oklahoma conditions. The remedy, then, for those who are interested in promoting the culture of the castor plant, is to be sought in the introduction or production of new varieties or sorts of castor plants, which will yield a higher grade of seed, and in the improvement of the varieties already cultivated, by careful selection of the seed for planting.

In grading castor seed in the St. Louis market the weight of a struck bushel of "beans" forms the basis of the system. The grades are; "Prime", 41 lbs. or more per bushel, sound and sweet, and free from frosted seed; "No. 2", 40 lbs. or more per bushel, and sound and sweet; "Rejected", 38 lbs. or more per bushel; and "no grade", weighing less than 38 lbs. per bushel. We are informed by Mr. W. F. Chamberlain, inspector for the Merchants Exchange of St. Louis, that during a period of five years the seed produced in Illinois averaged 43 lbs., in Kansas 42 lbs., and in Oklahoma 41 $\frac{1}{2}$ lbs. For the last season, owing to the drought, the average was lower in all these states.

The relative value of the different grades of seeds depends primarily on the relative percentage of oil in the seeds of the different grades. This percentage depends somewhat on the degree of maturity of the seeds, the completeness with which the seeds are filled out. But a most marked variation in the percentage of oil is found on comparison of the determinations of oil in the seeds of different varieties and sorts of castor plants. Samples of twenty sorts of castor seeds which were used in beginning a series of experiments showed, when the percentage of oil was determined by the Chemist, a range of variation from about 45 per cent to about 55 per cent. Samples of seeds of the same sorts grown in Oklahoma yielded, when tested in the same way, percentages of oil ranging from about 43 per cent to about 55 per cent. The average of the percentages was lower for the latter seeds than for those imported, as might be expected of the yield of unacclimated varieties of most cultivated plants. While the percentages of oil obtained from the imported and the home grown seeds of the same sorts did not correspond closely, most of the varieties which yielded more than 50 per cent from the purchased seed, yielded more than 50 per cent from the home grown seeds, and most of the varieties which fell below 50 per cent in the first test also fell below that per cent in the second test. This goes to strengthen the view that the amount of oil produced in any given castor seeds depends largely on the variety, sort, or strain of the plant or plants producing the seeds.

In the first of these tests the variety commonly grown in Oklahoma was represented by a sample of seed grown on the station farm, which yielded 46.33 per cent of oil. Plants grown from seeds taken from the same sack produced seeds of which a sample yielded 48.41 per cent of oil. A sample of the seed from another sort of castor plant grown in the same plat yielded 54.43 per cent of oil. It is hoped that, by selection of seeds based on tests of the percentage of oil as shown by chemical analysis, the station will be enabled to produce new sorts, or improvements of the old sorts, which will yield on the average a larger percentage of oil.

The second point which goes to determine the relative value of two sorts of castor seeds for planting purposes, is the amount of seeds which can be harvested from the plants of each sort. Other things being equal, the plant from which the greater amount of seeds

can be profitably gathered is the better one. The different varieties and sorts of castor plants vary greatly in the amount of seed which they produce. Most of the numerous varieties raised in this country are grown for ornament, and some of these produce no seed in our climate. This is not because the climatic conditions are unfavorable for growth, for some of these plants produce the largest of stalks. The plants simply do not come to a fruiting maturity in a growing season as short as ours. Then there are some of the ornamental varieties which produce seed in small quantities, and others which produce it in large quantities. In a test of the yields of a number of varieties of castor plants, those of the common sort produced much less than half as much seed by weight as the same number of plants of a number of other varieties. In this test the conditions were not uniform for all the varieties, but the difference in the yields seems to be greater than could be accounted for by the difference in the conditions. In each of the varieties which we have referred to as the ornamental varieties, there was also a very great difference in the amount of seed produced on the different plants. Some of the plants produced no seed at all, not even flowers, while others, growing under what would seem to be exactly the same conditions, produced large quantities of seed. The record of the yields of individual plants shows an enormous variation in the amount of seed produced by them. Unfortunately the records of this experiment, which was begun with another purpose in view, do not show the amount of variation in the seed production of the individual plants of the common castor plants grown under the same conditions. But we may safely say, from a general knowledge of plants, that this variation is considerable. And in general, the plant which ripens its first spike earliest, produces the largest quantity of seed in the season.

There are some other points to be borne in mind, in considering the improvement of the castor plant. The merit of a plant depends not only on the quality and quantity of seed produced by it, but also on the cheapness and completeness with which the seed may be gathered. It is the natural habit of the varieties of castor plants with which we are familiar, to discharge the seeds from the pods soon after they are thoroughly ripe. And as the different pods on a spike do not ripen at the same time, the lower ones ripening earlier than the upper ones, it is necessary to gather the spikes before all the pods are thoroughly ripe, in order that seed may not be lost by being

discharged from the ripest pods. There is a great difference in varieties in this respect. Although we have no systematically recorded information on the different varieties in regard to this point, observation has shown that the plants commonly cultivated ripen the pods of each spike more nearly at the same time than do some of the other sorts. But even if all of the pods on a spike ripen at practically the same time, a difficulty of the same nature remains, because the different spikes on the plant mature in succession, and on different plants at different times. This necessitates repeated gathering of the spikes at frequent intervals. An ideal plant which some cultivators would seek, is one which would mature its spikes late in the season and, at about the same time on all plants, so that the harvest might be accomplished in a short time. The ideal of other planters is a plant which matures its first spike very early in the season and continues to mature spikes until the end of the season, so that each such plant produces in the course of the season a large amount of seed. Toward which of these ideals the castor plant may be most easily improved, is a question which further experience and experiment must answer.

Were it not for the fact that the natural opening of the pods and discharge of the seeds is made use of in shelling them, our first thought and endeavor would be to secure plants on which the pods would not open at all, or better, would open only after the action of frost on them. If in any way we could secure such plants, and at the same time provide some threshing device which would separate the seeds from the pods, the gathering of the crop would be cheapened and the seeds on large spikes would be given time to ripen more uniformly. The difficulties in the way of this solution of the problem are great, but the matter is worthy of some serious attention in connection with any series of experiments or studies on the plant.

What is wanted by those who are engaged in raising the castor plant is some method of improving varieties which will begin to show returns almost from the start. The greatest opportunities in this direction are to be sought in systematic selection of the seed for planting. This selection should be made from seed grown in the neighborhood where it is intended to continue the culture of the plant. In other words, the man who raises castor plants should raise his own seed, or get it from his neighbor who has selected it according to some approved plan, rather than buy it from unknown sources. One rea-

son for this, is the fact that when a variety of a plant is properly cultivated in a particular region, the particular plants thus cultivated become, in time, specially adapted to that region, its climate and soil, and do better there than elsewhere, and do better in their adopted home than other plants of the same sort which may be introduced later. The plants after having lived for a number of generations under one set of conditions become adapted to those conditions, acclimated. The sort of castor plants which we have referred to as the one commonly cultivated in our territory, has this advantage over any other strains of the same sort which we might seek to introduce. They show it in a number of ways; by greater uniformity of stand, by higher percentage of germinating seeds, and perhaps by less variation in the amount of seed produced on the individual plants. But because they are acclimated is no reason why we should not seek further improvement of the variety. It is all the more desirable that we should endeavor to bring the variety in question up to the grade of the best varieties with a high percentage of oil in the seeds, and at the same time make it, if possible, productive of more seed.

A method of seed selection has been suggested by Mr. R. D. Kirkpatrick, of Benton, Illinois, who has had long experience in raising this plant. His plan is to cut for seed only the first spikes to mature. These spikes are larger and have fewer unmaturing seeds on them than those which are formed and ripen later. He cuts each of these first spikes near the middle, and saves for seed only the lower half, because the tops of all the spikes have some of the seed not well filled out. The lower halves of the spikes are thrown into sacks and hung up to dry. Treated in this way the pods pop open and discharge the seeds as they do when exposed to the sun. We venture to suggest that it would be well to have the sacks used for this purpose made of material which would give the drying pods good ventilation. The seeds are separated from the shells by running them through a fan. One advantage of this method of selecting the seed is, that the seeds thus obtained are all of high vitality, well developed and adapted to the production of vigorous plants. Then, too, seeds which mature early are supposed to produce plants with a tendency to ripen their first spikes early, and continued selection in this way for a number of successive years is expected to produce a strain of plants which will ripen their first spikes earlier than the stock from which selection was begun.

These very simple and practical directions for selecting castor seed may well be followed, and should give good results. A variation of this method which might be worth a trial, would consist in cutting the first spikes in two when they are yet only partly developed. The total sacrifice of the tops might be more than compensated for by increased vitality of the seeds on the lower halves of the spikes. Anyone disposed to give the matter a little more attention than is required to carry on selection by the method outlined above, may go further in the process and expect better results.

Two classes of seed may be selected, one for planting a special seed plot, and another for planting a crop. Both classes may be selected in the same way, but the first class with special attention, not only to the character of the spikes, but also to the character of the plants from which the spikes are taken. The object of this is to take advantage of the superiority of the few best individuals over the general run of the plants of a variety. The very best individual plants should, if possible, be picked out for this purpose. The points of superiority to be considered may be several or only one. They may include the quantity of seed produced and its quality, and also the character of the plant itself; as, for example, the height and mode of branching of the stalk. Short stalked plants might be given the preference as better adapted to stand high winds, and plants with short branches, or branches growing up at a sharp angle, might be chosen first, as better admitting of cultivation. Decide upon some type which will be an improvement and stick to it.

Choosing seed of plants on which the quantity and quality of the seed on the first spike show superiority, will be a comparatively easy matter. The number of well-filled or well-ripened pods on the spike may determine the choice. Choosing the plants which, in the course of the season, produce the most and best seed, is more difficult. It is accomplished at the Experiment Station by having a separate sack for the seed of each plant which is grown on the seed plot. The plants and sacks are numbered, and the seed of each plant is kept separate from all the rest until the close of the season, when it is a simple matter to weigh the seed from each plant separately and pick out the heaviest individual yields. And then the seed from each plant may be subjected to tests as to quality. The test used up to the present time is a chemical determination of the percentage of oil

in samples of the seed. It is hoped to devise some simple and easy method of estimating sufficiently accurately for practical purposes the relative percentage of oil in small samples by a specific gravity test. But at present the experiments have not been carried far enough to warrant proposing such a test.

The gist of the whole matter of seed selection is, select the best and earliest seed of a crop for planting, and when practicable select this seed from the best plants of a stand.

When raising plants for seed selection in a separate plot, which is advisable for a number of reasons, the individual plants should be grown as nearly as possible under the same conditions. When this is done it is much easier to decide which plants are really the better ones. If grown in rows they should be spaced as uniformly as possible by planting thickly and thinning. If grown on "hills", several seeds should be dropped in each hill, and when the plants are still young all but one or two should be removed from each hill.

To get good results from any work in breeding the castor plant in this territory one should give them thorough cultivation. It need be only deep enough to destroy all weeds and convert the crust which forms after a rain into a loose mulch. The plants need all the moisture they can get in the dry summers of this region, and the destruction of weeds and the stirring of the upper layer of the soil both serve to prevent the loss of water from the soil. The cultivation may well be continued through the season, as long as there are weeds to kill or a crust to break.

The most rapid improvement of the castor plants may be secured, as it is often done in the culture of other kinds of plants, by choosing for cultivation and selection varieties which exhibit a wide range of variation among the individuals. An increased range of variation may be induced in a variety by higher cultivation; as, improvement of the soil by the addition of manures, more thorough cultivation, and wider spacing of the plants. Increased variation may also be secured by the importation of seed from other regions; because individual plants react differently to changes of climate and soil. Lastly, increased range of variation is secured by the production of hybrids by cross pollination. Experiments in this method are now under way, and should in time yield greater returns than simple seed selection alone. But, as seed selection is necessary to secure results from hybridization, it is of highest importance, if any permanent direct

benefit is to be derived from these experiments, that systematic seed selection should be practiced by all who take any interest in the culture of the castor plant. The benefits obtained by seed selection cannot be expected to endure unless the selection of the seed is continued.

Not the least of the benefits to be derived from closer study and practice of methods of selecting castor seeds, will be the effect, which it can hardly help having, of leading to more studied selection by all farmers of the seed of other crop plants; such, for example, as cotton. The time will be hastened when farmers will no more think of getting their cotton seed for planting from the last ginning of a season, than they would of going to slaughter pens to buy blooded stock for breeding purposes. Cotton has been the subject of much study and culture, and in all the older parts of the cotton belt much attention is given to the selection of seed. Some planters devote most of their attention to the raising of seed for planting, and it is much to be desired that those who take the greatest interest in the culture of the castor plant should improve their varieties or obtain better ones, and make a specialty of raising seed for their neighbors, rather than dispose of it on the market for oil mills.