efforts will greatly increase the fishing opportunities in a region now subject to steadily increasing use.

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SUGARCANE Crossed With Sorgo Gives Seedlings Potentially Valuable

With due regard for inadequate conception of what constitutes a species and often also a genus in the plant world, it may safely be said that interspecific crosses are not common and intergeneric crosses are exceedingly rare. Well-authenticated examples of intergeneric hybrids in the crop plants are corn-teosinte and wheat-rye, but the majority of cases reported do not stand close scrutiny. It is of special interest, therefore, to record progress in crossing sugarcane (*Saccharum officinarum* L.) with closely related genera in the tribe Andropogoneae or bearded grasses.

As early as 1848 Leonard Wray, a progressive planter operating in Jamaica and later in India, published an account of experiments performed some years previously in which he attempted to cross sugarcane with sorghum (bajra) and Indian corn (boota). Mr. Wray's purpose was not to improve the cane but to find out if by this means sugarcane could be made to produce viable seed. His technic, part of which he owns may have been based on ideas perhaps fanciful, consisted of carefully removing the "eyes" or buds of each node on the prospective parents as they developed side by side, then bringing the "arrows" or flowering stalks into contact and shaking them smartly from time to time. His hope that he might get the flowers of the sorghums and corn "to impregnate and fructify those of the cane" was not realized, and he concluded that sugarcane will not "perfect its seed", a generalization that was disproved only after nearly a half century had elapsed. As a strange coincidence it was in connection with work leading to the discovery that sugarcane can produce viable seed that the next recorded attempts to cross *Saccharum* with other genera were made. In 1886 Soltwedel tried to cross sugarcane with *Erianthus arundinaceum* (Retz.) Jesw. reciprocally, but only the panicles of the wild form, *Erianthus*, produced viable seeds, and these may have been self-fertilized. Twenty years later Wilbrink obtained 30 seedlings from the cross *S. officinarum*×*E. elegans* (Jesw.) Ruemke, and subsequently Jeswiet repeated this cross but without success. Ruemke in 1927 and 1928 crossed sugarcane, EK–28, with *E. sara* (Roxb.) Ruemke and obtained several hundred hybrid seedlings, the somatic chromosomes of which are less than the sum of the haploid number of the parents. The reciprocal cross, *Erianthus*×sugarcane, was a failure, the plants thus obtained being due to self-pollination. Barke in Queensland in 1932 obtained 24 seedlings by crossing *S. officinarum* and *S. spontaneum* with "a species of *Erianthus*", no details being given to indicate whether the seedlings were actually hybrids.

Interest has been stimulated in the intergeneric crosses with sugarcane by the undoubted success of Venkatraman in producing hybrids in 1929 by fertilizing sugarcane flowers, variety P. O. J. 2725, with pollen of a grain sorghum, *Sorghum durra* Stapf. Individuals of the resultant progenies are characterized by wide variation in habit, vigor, and other characters, but morphological studies supported by

cytological evidence, together with the fact that the female parent is regarded as self-sterile, leave no room for doubting that the thousands of seedlings thus produced are intergeneric hybrids. The same investigator has also succeeded in backcrossing the hybrids, using as father the same variety of sorghum.

Object of the Experiments

The pursuit of knowledge and the hope that such researches may eventually lead to production of crop plants of economic importance is the double stimulus which prompts the attempts to secure and study these hybrids. The expenditure of effort and money in crossing the large, thick-stemmed, tropical sugarcanes with the slender, unprepossessing wild cane *Saccharum spontaneum* has already paid enormous dividends. In the hands of expert plant breeders interspecific hybrids of this parentage, endowed with resistance to devastating diseases and superior in yield to the larger parent, have been obtained. As yet the commercial value of the intergeneric hybrids is little known, but certain considerations, which bring out the logic behind these efforts, will make clear that hybridization with genera that are remote from *S. officinarum* is fully justified. Earlier maturity of sugarcane in countries where there is danger of frost damage is greatly desired. The advantage would be mainly to lengthen the period of harvest and grinding at the mill, and keeping the mill in operation longer by starting the campaign at an earlier date would obviously reduce the cost of fabricating sugar. Sorghum, while deficient in cane sugar, matures in little more than half the time required by sugarcane. Compared with 9 or 10 months as a minimum for cane, a few of the sugarcane-sorghum hybrids made by Venkatraman are said to mature in 5 or 6 months and yield satisfactory juices high in sugar. They have been disappointingly low in tonnage per acre, however, and improvement in this respect is being sought.

FIGURE 70.—Hybrid of sugarcane × sorgo in flower. In 16 years' experience the true sugarcane has not been known to flower in the greenhouses at Washington (latitude 38°55′ N.), but this hybrid produced inflorescenses there the first year. The flowers were infertile.

Looking toward plants of earlier maturity for Louisiana, Florida, and other Gulf States, the Bureau of Plant Industry succeeded in

crossing the sugarcane variety P. O. J. 2725 with the grain sorghum Red Durra, and the sugarcane variety I–1081 with Honey, a variety of sorgo, or sweet sorghum, in the fall of 1933. Of the 100 seedlings some have many of the characteristics of sugarcane, but show their sorgo parentage in the long and deep bud grooves, exposed roots of the "flying-buttress" type just above the ground surface, undulating leaf margins, and other gross characters, as well as in the chromosome number, intermediate between those of the parents (fig. 70).

Using the method of emasculating sorghum flowers with hot water, devised by J. C. Stevens and J. R. Quinby, of the Bureau of Plant Industry, the reciprocal cross, sorghum by a pollen-fertile variety of sugarcane, was attempted, but no viable seed was obtained.

The crossing was done at the United States Sugar Plant Field Station, Canal Point, Fla., and is being continued both in Florida and at the United States Sugar Plant Field Laboratory near Guayana, Puerto Rico. The difficulties involved in obtaining plants that meet all requirements are very great, and doubtless years of painstaking effort will be needed before any answer can be had as to the practical possibilities of this method of breeding. No plants are available in excess of the needs of the Bureau.

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TILLAGE Machinery Laboratory Expected to Yield Valuable Data The development of farm machinery and tillage methods in the past has been largely through empirical methods. The basic relationship between soil types, machine design and operation, and crop production was not known. The difficulties encountered in handling soils in many areas, such as the Black Belt of Alabama and Mississippi, where the topography is well adapted for cultivation with standard-sized machines, resulted in the abandonment of portions of these areas in favor of the eroded and impoverished hill areas, where soils are more easily tilled. There are few plows which will work satisfactorily in waxy, heavy clay soils, which will shed and scour in "push" soils, or will withstand the abrasion of gravelly soils.

In all studies thus far made of tillage machinery under field conditions there have been variables which could not be controlled by the investigators. For instance, it has been impossible to control the soil moisture or to duplicate exactly any set of conditions. The accuracy of field work has also been handicapped by reason of the fact that the testing equipment used had to be supported by the soil under test, resulting in uncontrollable errors. These handicaps to the proper scientific study of the manifold problems connected with tillage have long been recognized. It was realized that the answer to many tillage-machinery problems could not be found unless the studies were made where soil conditions were within the control of the investigator.

To meet this long-felt need a farm-tillage machinery laboratory has been constructed at Auburn, Ala., with funds furnished by the Public Works Administration. The plant consists of 9 soil bins each 250 feet long, 20 feet wide, and 2 feet deep, 2 of the bins being divided in the center. The bins are separated by concrete walls on which are placed rails which support the testing equipment. The testing equipment includes a power car propelled by a 130-horsepower engine, which will make possible the operation of tillage machinery at speeds