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THE TREATMENT OF CANE SETTS WITH MERCURIAL SOLUTIONS

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By C. G. Hughes.

Introduction.

As long ago as 1870, when the sugar industry in Queensland was in its early infancy, a practical farmer said, "It is a natural presumption that both heat and moisture are necessary to develop the vitality of the cane sett," and an agricultural journalist associated with the paper, "The Queenslander," was moved to write of cold soil: "Plants put into it while in that condition vegetate but slowly; there is also some danger of losing them altogether, from absence of the stimulating heat which the more advanced season finds in the soil." The experience of nearly 80 years has served to emphasize the truth of these remarks and cane farmers generally are now aware of the conditions required for a satisfactory germination in a particular variety. The importance of a rapid, even germination in the production of a successful, profitable crop is also fully realised. A poor strike may force the replanting of a field and even if it does not, weeds grow in the gaps in the rows and frequently seed to be a nuisance in subsequent years; covering-in is delayed, and crop yields are reduced; and there is also the extra expense of supplying the misses, a practice which frequently can cost almost as much per acre as the original planting and then not repay the expenditure.

The cane sett in the ground is subject to attack by the fungi and bacteria of the soil and for some time after planting is particularly vulnerable. It is planted when in a dormant state and has to undergo chemical and physiological changes, the exact nature of which are not yet understood, before the roots and shoots come away to establish a new plant and a new crop. Any organic material in the soil, unless actively growing or specially protected, is soon decomposed by the soil organisms. The newly-planted cane sett is not actively growing and although the rind does provide some protection, the cut ends are ideal breeding places for all kinds of organisms, for a cane sett will not grow a protective callus like a rose slip does. The cutting kills the cells and the exposed surface is moist with a nutritive, sugary sap on which the fungi and bacteria can thrive. An indication of this activity can be easily seen on the stubble left after harvesting the grown crop; it is covered with fungal growths of various colours or bacterial slime within a few hours. The organisms established on the cut ends of the sett may grow very actively into the sett and rot it before the buds and roots have shot, and a failure results. The invading organisms may be common inhabitants of the soil, not especially important except for their ability to rot organic material, but frequently a very active fungus called *Ceratostomella paradoxa* is involved, and the rotting sett then gives off a fruity, fermenting smell like that from ripe pineapples. Hence the popular name of "pineapple disease" applied to this form of sett rotting. Apart from the smell, the early symptoms of the disease in the sett are a blackening on the cut end or ends and a light reddish or reddish-brown watersoaked appearance, which is exposed by splitting the sett. Later the black discolouration extends into the sett, usually down the middle, and it soon disintegrates. Fig. 1 shows a sectioned sett of the susceptible variety Q.52 with the blackened areas of pineapple disease extending into the discoloured body of the sett.

Note that neither the roots nor the shoots of this plant had germinated. The fungus has been found in the soil in every cane-producing area in Queensland.

The pineapple disease fungus lives in the soil but under certain circumstances it can attack living plants. Incidentally, this fungus is the same as that causing soft-rot or water blister in pineapples and stem-end rot in bananas. Occasionally pineapple disease has been seen in standing cane seriously affected by some other agency. For example, in the Mulgrave area in the winter of 1949, pineapple disease was found in stalks of a severely grub-damaged crop. The stalks were nearly, although not quite dead, and, in view of the popularity of grub-damaged cane for plants, a careful examination should be made of the most severely damaged sticks before the crop is used for plants. If on splitting, the near-dead stalks show the disease, then it is certain that many others have it in a less conspicuous form and the block should be discarded as a source of plants, for it is obvious that no treatment of the sett would control the fungus when it is already well established in the tissues of the plant.

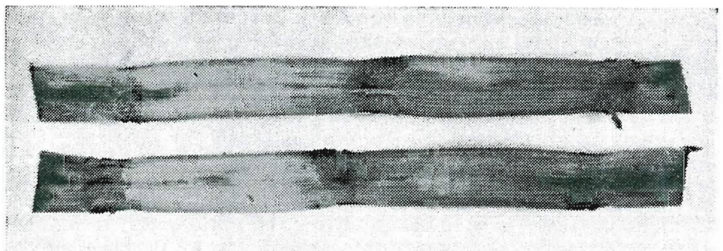

FIG. 1.—A sett of Q.52 split lengthwise showing discolouration due to pineapple disease. Note that the sett did not germinate.

Up to this point the emphasis has been on the helplessness of the sett in the ground and the aggressiveness of the rotting soil organisms, but the fact is that, as with most diseases, the relationship between the disease-causing organisms and the body affected is delicately balanced and very sensitive to outside influence. In this instance temperature and moisture are of prime importance, as the practical farmer pointed out. If the temperature and moisture be suitable for the causal organism, the disease results; if the sett be favoured, a new plant is established. It has been found that the fungus of pineapple disease will grow at a temperature at which commercial varieties of cane show no sign of growth. Temperatures in the soil of about 70°F. or under are not suitable for the germination of cane setts, but are not sufficiently low to prevent the growth of the fungus; the result is that in cold soil the sett remains inactive, while the fungus proceeds to destroy it. At higher temperatures the ability of the sett to germinate is enhanced to a greater degree than is the activity of the fungus (and other soil organisms) and there comes a stage at which the sett wins the day. It is obvious that soil temperatures are not readily subject to control although the temperature in the immediate neighbourhood of the sett does depend to some extent on the amount of cover; the greater the cover, the lower the temperature. However, the natural balance between sett and fungus can be upset by stimulating the plant to earlier growth or by protecting it for a sufficient period against the

invasion of the fungus. Stimulation of the sett may be obtained by treatment with hot water and there may also be some use for plant hormones in this role, but the protection of the sett offers most hope at the present in the improvement of germination. This involves treating the sett, including of course the cut ends, with a fungicidal substance, or else erecting some mechanical barrier against the entry of the fungi and bacteria. A mechanical sealing of the sett is not practicable, although some of the earlier workers found that dipping the cut ends of the setts in tar gave some protection, and it would appear that recourse must be had to treatment with a fungicide of some sort. Owing to the amount of seed material involved and the risk of injury to the buds the use of a dust would not be simple, so a fungicidal solution seems to be the answer.

A good deal of investigational work has been undertaken both in Queensland and overseas and a general discussion of this would be of interest before proceeding to a description of the practical application on Queensland farms.

Practices in other countries.

The original description of pineapple disease and the first realization that this fungus could cause serious losses came from workers in Java in the decade 1890-1900, but soon afterwards the world-wide interest of the planters in germination troubles was shown by the initiation of experiments in localities as far apart as Hawaii and the West Indies. A wide range of substances was tested at various places. The combination of tar with such chemicals as carbolic acid, Bordeaux mixture or alcholol or with a mixture of sulphur, resin and lime appealed to many of those carrying out the tests as a suitable sealer for the ends of setts. Solutions tested included Bordeaux mixture with or without molasses, sulphur, resin and lime, formalin, limewater, copper sulphate and as indicative of early Queensland interest, a "Queensland solution," which was tested in the British West Indies but whose formula is not known. Variable results were obtained from these early tests and none of the methods tried came into immediate general use.

In Mauritius, however, several plantations followed the recommendations of the local Department of Agriculture and had adopted as standard practice the treatment of setts with Bordeaux or Burgundy mixture prior to 1925. Later it was found that a soaking for 18-24 hours in a saturated solution of lime had markedly beneficial effects on germination and early growth and was adopted wherever practicable on the island. Although limewater is not a strongly fungicidal solution the lime may have some detrimental effect on the fungus and the water absorbed during the soaking hastens the germination. Recently it has been shown that mercurial preparations, particularly the proprietary compound, "Aretan," gave increased germinations compared with the lime treatment and it is presumed that the mercurial dipping will displace the overnight soaking in limewater.

In Hawaii, the treatment of setts with "Ceresan," another organic mercurial, gave a better germination than the untreated during the comparatively cold, wet months and, according to a recent report by Mr. J. L. Clayton of the mill technology staff of this Bureau, some plantations now make a regular practice of dipping the setts.

Plantings in South Africa have frequently to be made when low soil moistures and temperatures are the rule and poor germinations are very common there, especially since the introduction of the newer varieties and the displacement of the hardy Uba. It is not surprising then that the pathological staff of the South African Sugar Experiment Station should have devoted much time recently to the experiments aimed at improving germination. Extensive tests there with a range of dusts and solutions demonstrated the superiority of the organic mercurial preparations and, although the method now in practice involves extra labour and extra handling at planting time, the *South African Sugar Journal* reports that many thousands of acres of treated cane were planted in 1946, much of it under conditions in which planting would not normally have been attempted, and that replanting on many estates was reduced to a negligible amount. The major benefit appears to be that advantage can be taken of light showers, normally insufficient to permit planting. The South African treatement consists of dipping the setts, arranged in bundles, in shallow vessels of the solution so that the cut ends are immersed; an instantaneous dip is all that is given. If this were the only method available for treating the setts, it would have very little application in Queensland but fortunately the commercial methods developed here and discussed below are more efficient and, with properly organised labour, much cheaper.

Experimental Work in Queensland.

Farmers in the Burdekin area, particularly to the south of the river, have always had to contend with poor germination, especially when plantings were made in the cool weather. There are records of complete failures on some farms and, in 1936, the failure of a single planting of 60 acres brought home forcibly how serious losses could be. At that time, although, as mentioned above, Mauritius estates were treating setts by soaking on a commercial scale, there was no method in sight which would be applicable to the Burdekin area. That year the Pathology division of this Bureau initiated experiments and in the course of the next few years found out a good deal about the fungus chiefly responsible for the disease, evolved a control, and offered it to the farmers. Their wholehearted acceptance is a matter of very recent history.

It was soon found that the fungus could remain alive in soil for quite long periods even when cane was not being cultivated, so there was no hope of control by fallowing the fields. There was also the interesting discovery that the spores of the fungus were fairly widespread in a cane crop and that most sticks carried some on the rind. These spores could lead to infection when the sticks were cut and planted even if the disease had not been recorded in the block before. The presence of these spores, possibly in minute breaks in the rind or about the root or shoot buds, might explain why attempts to control the disease by sealing the cut ends mechanically have not been a success. It was found, for instance, that wax or pitch on the ends did not prevent setts contracting the disease even when there were no obvious growth cracks present. The dipping of the ends in Bordeaux mixture or, in later experiments, in mercurial preparations was likewise not a complete success. It was thought that perhaps a drying of the cut ends before planting might render them unsuitable for the growth of the fungus and invasion of the sett. However, it was proved that the drying offered no protection.

The fact that the fungus lives in the soil prompted experiments aimed at killing it by the addition of fungicides to the prepared ground. It was found that the addition of mercurial preparations at the rate of

1 part to 10,000 parts of soil would inhibit the growth of the fungus into setts planted in it, but this dressing on a commercial scale would be very expensive, not permanent, and moreover the fungicide would upset the natural microflora with unpredicable and probably damaging results.

Since the pineapple disease fungus and other rotting organisms came into the sett from the outside, it was thought that the dusting of the setts with a fungicide might be beneficial, in the same way as with cereal grains. Dusting of the two tons or even more of cane plants needed per acre in such a manner that the buds would not be damaged would be a major mechanical problem and would certainly need elaborate and expensive equipment. Dust could be applied to the cut ends of the setts by a laborious hand dipping process, which might, under certain circumstances, be worthwhile if results were guaranteed, or the dust could be applied to the sett in the drill. Neither method was a success and it was obvious that a solution treatment would be the most generally acceptable.

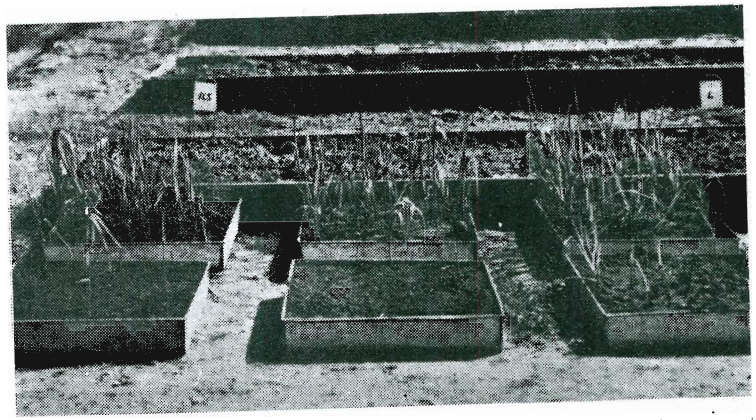

FIG. 2.—Results of an early experiment with mercurial treatment of cane setts. Back row soaked overnight in mercurial compounds; front row untreated, a failure due to pineapple disease.

Experiments showed that mercury was apparently the most useful fungicidal element available; mercurial preparations were much more effective than copper, for instance. The result of an early experiment, made before any field application had been developed, is shown in Fig. 2. The galvanized-iron trays were filled with soil which contained spores of pineapple disease and setts were planted in each tray. The setts in the three trays in the back row had been soaked in different mercury compounds while those in the front row had received no treatment at all or else an ineffective treatment before the stalks had been cut into setts. The marked difference in germination four weeks after planting is very obvious.

The early field application of the knowledge gained in small-scale trials included the use of dilute solutions of various mercurial preparations. Satisfactory results were obtained with a number of substances including the pure chemical, mercuric chloride or corrosive sublimate. However, concentrated substances of this type are extremely dangerous to human life and it was considered that diluted commercial products would be much safer to handle and just as effective. A wide range of products was tested but it was found that those readily available, "Aretan," "Ceresan" and "Agrosan," were quite as promising as the others. The solutions used in the tests contained a uniform percentage of 0·003 per cent. mercury and at this strength it was necessary to soak the plants overnight. The results obtained are well illustrated by Fig. 3, showing adjacent rows in a germination trial on the Northern Experiment Station at Meringa, near Gordonvale. Setts in the row on the left were soaked overnight in 0·2 per cent. Ceresan solution (containing 0·003 per cent. mercury); those in the

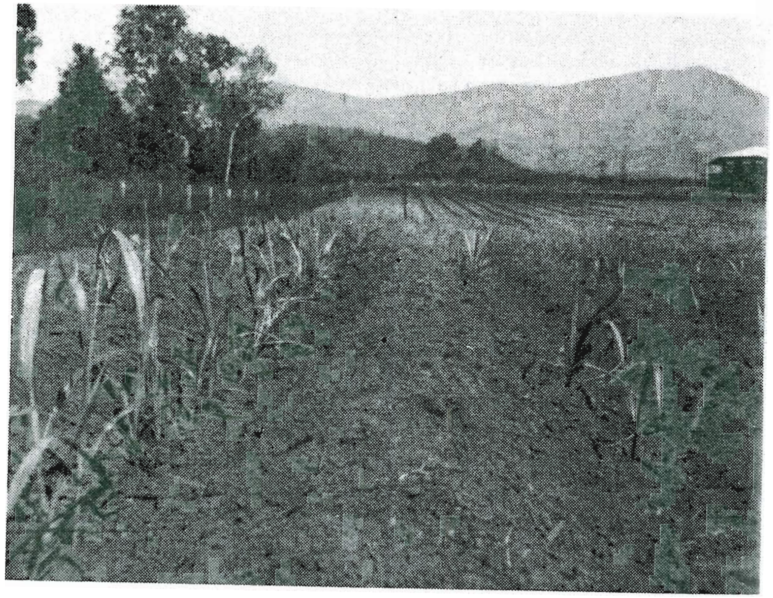

FIG. 3.—Portion of a germination trial on the Northern Experiment Station, Meringa. Setts in the row on the left soaked in Ceresan, those on the right in water.

row on the right were soaked in water only. It can be seen that germination is complete from the treated setts, whereas many supplies will be necessary in the other row. The same effect between treated and untreated rows showed in the other replications in this properly designed trial so the differences were undoubtedly due to the treatment and not to chance alone. Other mercurials in the trial also showed similar beneficial effects.

The results from a number of trials showed that when pineapple disease was present the treatment of plants in the stick was not effective. This was only to be expected in view of the knowledge that the cut ends of the setts were the most obvious points of entry for the rotting fungi. It meant of course that the cutter-planter would have to be discarded in favour of the older drop-planter, but farmers in the severely affected areas are quite willing to do this in their attempts to obtain better germinations.

It must be admitted that if all plants had to be soaked overnight in a fungicidal solution there would not be many farmers willing or able to afford the expense and some more expeditious and cheaper method was sought. Trials did show that germinations were frequently more rapid when setts were soaked overnight in comparison with dipping for a few minutes in a stronger solution but the difference was not great and appeared to be due more to the effect of the soaking as such than to any beneficial effect due to a more prolonged contact with the fungicide. It was felt that the soaking method would never be a commercial success, whilst responses to the dipping gave every indication that it would pay very well on a farm scale. Whereas solutions for soaking contained 0·003 per cent. mercury the solutions for dipping were increased to 0·015 per cent. mercury, i.e., 1 lb. per 10 gallons for

FIG. 4.—A strip trial on the Burdekin, showing the strike from untreated setts (left) compared with that from mercurial-treated setts planted at the same time.

Agrosan and Ceresan and 1 lb. to 20 gallons for Aretan, which has double the mercury content of the other two preparations. The period of dipping in the solution did not appear to be of much significance so long as the setts were wet thoroughly. In practice, half a minute was all that was necessary; at the other extreme, a dip for two or three hours did no harm.

Well-designed germination trials were conducted on the Experiment Station and on some farms, but as soon as the benefits of treatment with mercurials became known, farmers in affected areas understandably refused to have trials on the checkerboard system, made familiar by Bureau fertilizer and variety trials, in their fields, since they involved leaving some untreated plots as checks for the various treatements. The only alternative was to run strip trials on a number of farms and trust that the replication would eliminate soil and other variations affecting each strip plot. Many of these trials were put out on farms in the Burdekin area this year, 1949, and excellent results were obtained. The wet season had been unduly prolonged and when planting commenced in May—approximately six weeks later than usual—the soil was already cool and generally poor germinations were anticipated. The strips treated with mercurials gave excellent germinations without exception and the predictions of poor strikes were well borne out in both the untreated strips and in fields planted with untreated setts. Fig. 4 is a general view of one of the strip trials, photographed late in July, just nine weeks after planting. The rows to the left of centre had been planted without any treatment of the setts, and four on the right with the mercurial, Ceresan, while beyond this four on the extreme right was a repetition of the untreated section. The four treated rows had completed germination, or at least a satisfactory stand had already been established; the rest of the block showed odd shoots (only two were seen in one 100-ft. section of row) and would never make a complete stand since many of the setts were dead. This farm is at Airdmillan on the Ayr side of the Burdekin River and is recognised as a heavy producer. The variety is Badila.

Strip trials are valuable for demonstration purposes and where large differences are expected can be very useful. They are not so helpful in evaluating the smaller differences which occur, for instance, between the results from the different brands of mercurials now in general use. It is necessary, therefore, to combine the results of many years and many trials, both demonstrational and otherwise, for an evaluation of the respective merits of the different preparations. There is no doubt that treatment of the setts by dipping in solutions of Aretan, Ceresan or Agrosan will effect an improvement in germination and, in addition, a product known as "Abavit S" which is not yet on the market here, is also effective. However, at the moment it is considered that Aretan is the most generally useful in Queensland, Ceresan appears to be almost as good but Agrosan is not as effective over such a wide range of conditions as the others. Abavit S shows promise but has not been tested on a commercial scale.

Practical Application in Queensland.

Although the germination trials were conducted in several districts and it was shown that pre-planting treatment of setts would be successful with most varieties when planted under adverse conditions, it was in the Burdekin area that treatment was first adopted on a commercial scale. The reasons were that this area was as a whole more subject to poor germinations through soil-borne diseases than anywhere else in the Queensland cane belt. On the worst affected farms a second or even third complete replanting of fields was common before a satisfactory stand resulted and in many instances where replanting was not done, the cost of supplying misses was almost as great. Since for various reasons ratooning on these irrigated lands is not a general practice the whole cost of the supplying or multiple planting had to be borne by the one plant crop. The cost of production was thus increased abnormally and it is a fact that several farmers have stated they would no longer be on their farms had the mercury treatments not been brought to their notice. As in other districts the average germinations obtained varied from season to season but every year certain farms or even certain fields on some farms gave poor germinations and in a bad year such as 1949 bad strikes were common throughout the area.

The chief reasons for the poor germinations on the Burdekin, particularly on the farms to the south of the river, lie in a combination of climatic, agricultural and economic factors. Autumn planting is desirable on two counts; firstly, the popular varieties are long-season canes and do not do so well when planted in the spring, and secondly, the farmers desire to complete their plantings before the crushing with its attendant shortage of labour and rush of work commences. The planting then is done as soon as possible after the end of the wet season. Should this season finish early and the land be workable during late summer, fields will be planted by the end of March, i.e., while the soil is still warm, and plants of most varieties then come away very quickly. Floods, however, or perhaps an extension of the wet season may delay cultivation so much that little planting is done anywhere in the district before May. The soil is then cooling and the seasonal, cool, drying winds and necessary waterings keep the soil cold while the crop is attempting to establish itself. Such conditions are, as mentioned above, ideal for the pineapple-disease fungus and, in consequence, poor strikes follow. In other cane areas the same conditions do not usually hold for the same length of time. In the south, for instance, the term "autumn planting" is used but it refers to a planting which is more usually made during summer and the crop is above ground by the time the temperatures drop. In the north, pineapple disease often causes poor germination but, with the higher temperatures prevailing, there is a greater latitude with regard to time of planting and for practical purposes, providing the month of June is avoided, strikes obtained with most varieties are fairly satisfactory. Despite this, demonstration plots in the north have been a success and some farmers have dipped their setts when they realised that conditions were not favourable for germination.

The solution used for dipping should contain ·015 per cent. mercury which may be obtained by dissolving ½ lb. of Aretan or 1 lb. of Agrosan or Ceresan in 10 gallons of water. Aretan contains three per cent. mercury in an organic combination and was designed for the solution treatment of potatoes, bulbs and corms, &c., and is readily soluble in water. It is priced at 84s. per 7 lb. tin in Brisbane and although containing twice as much mercury as the two other preparations, is still more expensive per unit of the active ingredient. Ceresan contains 1·5 per cent. mercury and is used primarily as a dust for the treatment of cereals against seed-borne fungal diseases. It costs 25s. 8d. per 7 lb. tin. Agrosan has the same mercury content as Ceresan and like it, was developed for the dusting of seeds prior to sowing; it does not mix readily with water owing to the large proportion of insoluble carrier, which may be responsible for the irregularity of results obtained with this mercurial. It retails at the same price as Ceresan. In making the solution the required quantity of mercurial is mixed into a paste with a small amount of water, then added to the bulk of water. Care should be exercised that this poisonous paste does not get on to the bare skin as it will cause serious blisters which may lead to a general mercury poisoning. The diluted solution will not have any effects on the skin of the forearms and hands of the average person but should not be left where stock can drink it. It will keep for several weeks and, when finished with, may be disposed of by allowing to run on to the ground, where the active mercury compounds are very shortly made insoluble and non-poisonous by the soil micro-organisms.

Several types of equipment have been developed for the dipping of setts on the farm. They range from small, simply-made baskets holding about a bag of plants to large set-ups including a crane and capacious tank capable of handling a planter-box full of setts in the one dipping. The small baskets are made of wire-netting and strap-iron and hold about one bag of setts. One type, squat in shape and

FIG. 5.—Hand baskets holding one bag of setts each used for dipping in mercurial solution.

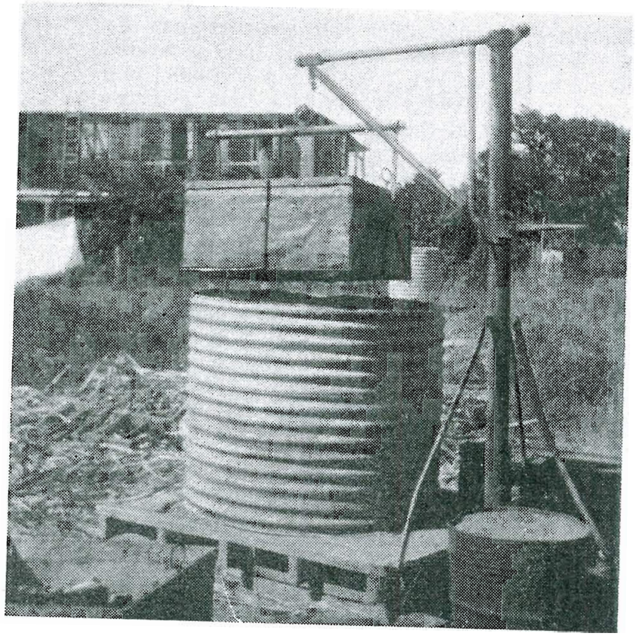

FIG. 6.—Simple inexpensive dipping plant. Note small crane and galvanized-iron baskets holding five to six bags of plants.

covered with chicken-netting is shown in the illustration (Fig. 5). It is used in conjunction with the small corrugated-iron tank shown mounted on a slide, and is man-handled into and out of the solution. Another type of small basket not illustrated here is of the same capacity but is taller and roughly circular in shape so that it can be used with a 44-gallon drum. Several baskets are used with the one drum or tank so that there is a minimum delay when the planter has to be refilled. If the drills be so long that the planter will not do the round in one filling a tank is installed at each end. The setts are cut directly into the basket, which is then put in to the solution for anything from 30 seconds to several minutes (even an immerson of two hours or more does not appear to be harmful), lifted up, allowed to drain on the edge of the tank or on a roughly made framework, and then emptied. The handling of

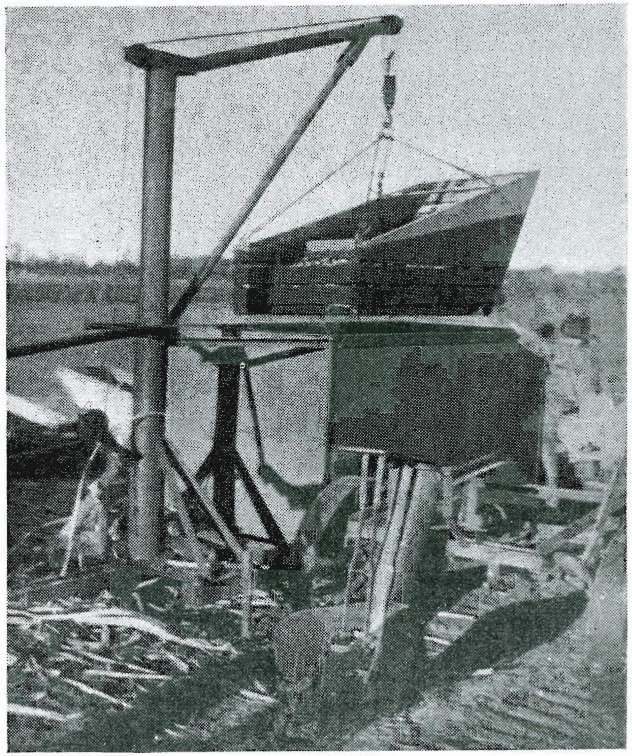

FIG. 7.—Large dipping plant, showing full detachable planter-box draining after immersion in solution.

these small baskets full of setts is very hard, back-breaking work owing to the fact that the lift cannot be made close to the body and even with two men to each basket requires considerable muscular exertion in a position of some strain. However, despite this drawback six farmers on the Burdekin found it worth the trouble and labour involved, and between them treated 160 acres in the one season.

Except for the smaller-than-average farmer or the farmer who treats only portion of his planting, there should be no need to persevere with the laborious small-basket system and farmers, in collaboration with Bureau officers and the local smiths and engineers, have evolved several types of dipping equipment capable of handling the setts for quite large areas. The simplest of these is shown in Fig. 6. It consists of a small crane and tank mounted on a wooden slide and can be made from scrap material commonly found (in normal times) on most farms. The square, comparatively shallow baskets are made of galvanized iron which is continuous at the sides but well perforated at the bottom. Each holds five to six bags of plants and can be tipped readily to empty. They are lifted by means of the crane with a flexible

FIG. 8.—Large dipping plant, showing the planter-box full of dipped setts being lowered into place on the planter-frame.

wire rope connected directly to a hand-driven windlass. The tank consists of 1½ sheets of a domestic, galvanized-iron tank which, in order to minimize the wear and tear, should be coated with a bitumastic paint and fitted with a false bottom to take the weight of the basket. It is a simple arrangement suitable for a small team of men and has been used for both initial plantings and the treatment of supplies. It would not last as long as the heavier plants, and there would be some delay in loading a large planter-box, but this type of plant should fulfil a useful purpose on many farms.

The plant shown in Figs. 7 and 8 is much more substantial and is obviously built for solid usage over a long period. The well-built crane is mounted on a platform with a 1000-gallon steel tank and, although the rollers are rather small for movement on loose earth, the plant can easily be towed by a tractor along reasonably smooth headlands. The platform is sufficiently heavy to stand the strain of movement with the tank holding the 600 gallons of solution required for the dipping. There are no baskets for this plant but instead three detachable planter-boxes have been made. Fig. 7 shows a full box, draining after dipping with the planter-frame drawn alongside ready to receive its load. The next stage, shown in Fig. 8, is the lowering of the box on to the planter. Its weight keeps it in place and it is lowered and fixed with a minimum of delay. With three boxes for each planter, at a given time, one box is on the planter, one in the tank or draining and one on the ground being filled with cut setts. With this particular plant a tractor or truck is hitched on to the end of the wire rope, and it would be an improvement to have either a motor or strong, geared windlass installed on the frame. However, even as it is, this plant is quite efficient and there is very little delay in loading the planter.

The most ambitious dipping plant yet put into use also has a 1000-gallon steel tank and heavy-duty crane mounted on a frame. Improvements include the substitution of wide-tyred wheels for the rollers, the incorporation of a swivelling front axle with provision for running over broken ground without twisting the chassis, the provision of a geared windless and the use of special large baskets instead of the detachable planter-boxes, the use of which would have necessarily been confined to suitably altered planters. The outfit can be easily hauled about the farm when in full working order with 600 gallons of water in the tank. The windlass, which can be seen on the left in Fig. 9, is geared so that one man can raise the loaded basket without undue effort and at a reasonable speed. The baskets (see Fig. 10) are strongly made of hardwood with metal corners, and hold about 16 bags of plants, i.e. sufficient for 40 chains of drill. The baskets are fitted with a special dropping device by which a pull on a lever allows the two flaps forming the floor of the basket to open and so release the setts into the waiting planter. Although the basket is usually up to two feet above the bottom of the planter-box when the setts are released it is found that there is no obvious damage to the eyes in the fall because the wet setts slide over each other without any violent bumping. Occasionally, a long sett gets stuck crosswise as the load is being dropped but the elimination of the crossbar on which the flaps lock would prevent this. With this plant operating to capacity the bottleneck was the speed of the planter putting the setts into the ground and with a suitably balanced team of men several planters could be served at once at a lower cost per planter. This type of plant costs more than £200 but the price would have been considerably less had not shortage of steel forced the manufacturers into a good deal of expensive improvisation.

In the methods of treatment described above the setts are cut directly into the basket or planter-box, as the case may be, and farmers have asked if it is necessary to have the setts thus freshly cut or whether it would do any harm to have the setts cut, say, the day before dipping. Although there have been no quantitative trials carried out on this point, observations tend to the conclusion that the drying-out of the cut ends before dipping can only have a beneficial effect, providing of course there

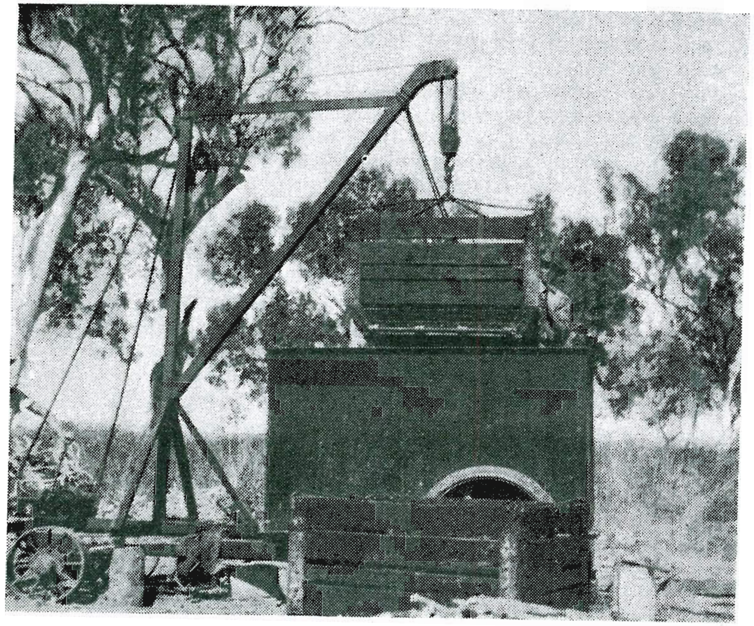

FIG. 9.—Large dipping plant, showing general set-up and geared windlass.

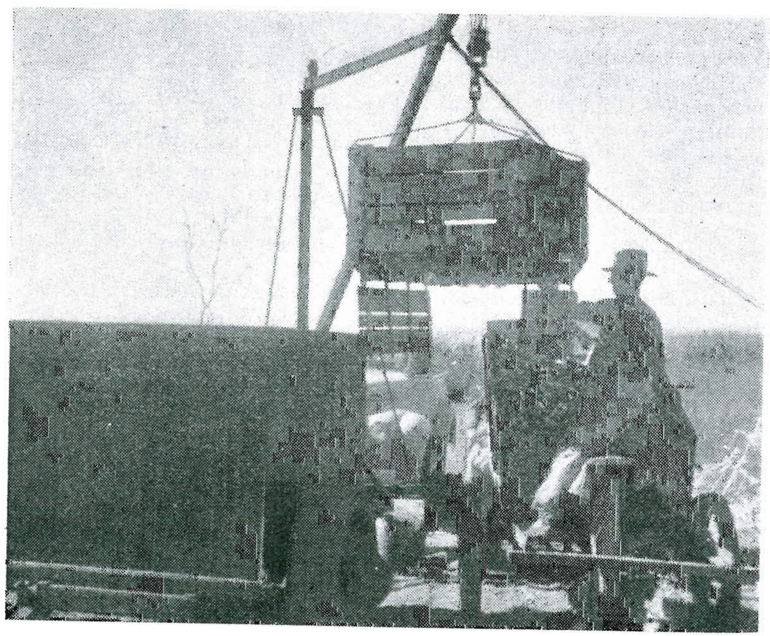

FIG. 10.—Large dipping plant, showing the loading of the planter with dipped setts.

is no general drying of the sett as a whole; but it is not desirable to allow setts to remain unplanted for any length of time after dipping. During the drying small cracks develop and it is preferable that they develop before dipping so that they will be filled with fungicidal solution when the setts are treated; if the treatment be done first and drying occurs afterwards, the cracking exposes fresh surfaces which will not be covered with protective fungicide when the sett is put into the soil.

The Economics of the Treatment.

It is obvious that with our present knowledge it is not possible to use the cutter planter in combination with a mercurial treatment, and any consideration of the economics of the fungicidal dipping must include some reference to the fact that a drop-planter must be used. Within recent years cutter-planters have become popular in many districts and there are at the moment several manufacturers making them to meet an increasing demand. However, enquiries amongst farmers have led to the conclusion that, although the cutter-planter may mean a more expeditious planting, when all angles are considered on most farms the new planters may not be any more economical than the old, and in discussing the costs of the dipping treatment that is assumed to be true.

On farms such as those in the Down River locality of the Inkerman area where satisfactory strikes are less common than poor ones in most years, the installation of a dipping plant would be justified even if it added considerably to the cost of the original planting. The added cost would be more than repaid by the money saved through not having to supply extensively or to replant, which are both expensive and annoying operations. In most parts of Queensland, however, good strikes are the rule providing the land has been well prepared, temperature and moisture are adequate and the germinating habits of the particular variety have been considered, and in these cases any extra expense at planting would not be justified. It came as a pleasant surprise then to find out that the insurance provided by the dipping could be obtained at no extra cost if the area to be planted were sufficiently large as to justify the use of an efficient dipping plant. The hand-basket method is not regarded as economical and should be used only for small areas or in case of emergency. The added cost when using these baskets is difficult to estimate but it is apparent that some extra cost, which must be weighed against the possible advantage, is involved.

Disregarding allowances for depreciation on the tractor, planter and truck and other miscellaneous expenses incurred whether the setts be dipped or not, it would cost approximately £428 to plant 40 acres with a drop planter. The required team of eight men would plant at the rate of five acres per day and 2½ tons of cane would be required per acre. In case this figure may appear somewhat on the heavy side to farmers in other districts, it should be pointed out that with the heavy, thick-barrelled varieties popular on the Burdekin three tons per acre are frequently planted, and the figure of 2½ tons is if anything below average. The 40 acres would thus require 100 tons of plants and on present prices the farmer would have to pay £3 per ton for this uncut in the field. The labour for 40 acres would amount to 64 man-days which at the moment could not be obtained for less than £2 per day.

In comparison, the planting of 40 acres with dipped setts would amount to £399 or £409 (depending on the mercurial used) as set out below:—

Plants—80 tons at £3	£240
Labour—9 men for 7 days at £2 per day	£126
Depreciation on dipping plant—10 per cent. on £200	£20
Mercurial	£13–£21
	£399–£407

The guarantee of a good stand because of the dipping means that the planting rate per acre can be substantially reduced. The reduction would amount to at least half-a-ton per acre and in many instances much more. One farmer who was accustomed to plant 3½ tons before he dipped now uses just half this quantity and obtains excellent stands. An extra man is required for the dipping-planting, the team consisting of three men cutting and carting, four stripping, cutting and dipping, one on the tractor and one on the planter. The reduced tonnage planted, the extra men and the speed with which the planter is loaded by the large basket or detachable-box equipment allow a slight increase in the speed of the planter and a reduction in the time it has to remain idle during the day with the net result that an extra acre per day can be planted. This means that only seven days instead of eight are required to plant 40 acres. Depreciation on a £200 dipping plant has been allowed for at the rate of 10 per cent., and costs of the mercurial are set down at £13 to £21. The lower figure represents the cost of 70 lb. of Agrosan or Ceresan, i.e. sufficient for 700 gallons of solution; the equivalent amount of Aretan would cost £21. It is worth noting that the cost of the mecurial represents only five per cent. or less, of the total cost of the planting and the difference in price between the cheaper mercurials and Aretan is 4s. per acre.

Summary.

Experiments both here and overseas having shown the effectiveness of mercurial preparations in preventing infection of the planted setts by pineapple disease and other soil-inhabiting organisms, the dipping method of treatment has now been established as practicable on a farm scale. Several dipping plants, ranging from hand-baskets to large baskets or detachable planter boxes lifted by cranes, have been in operation on the Burekin and without exception, striking improvements in germination have been obtained. With the larger plants the increased acreage planted per day and the decreased tonnage of plants needed compensates for the cost of an extra man and the mercurial, and the insurance against a poor strike is thus obtained at no extra cost. Mercurials used at present are Aretan, Ceresan and Agrosan with Aretan generally more suitable than Agrosan over a wider range of conditions; Ceresan appears to be satisfactory and in a small trial a new preparation, Abavit S, was found effective. The dipping in mercurial solution will not overcome the handicaps of poor plants or poor preparation of the seed-bed but it is decidedly useful when, other conditions being satisfactory, plantings have to be made in cold or dry soils. It should be worth considering as a standard practice in the northern mill areas where late autumn planting, i.e. before the mills commence crushing, is so desirable, and for the treatment of setts being put in as supplies it is strongly recommended for every district.

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