BROADCASTING VERSUS TRANSPLANTING OF RICE

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Introduction. Of the two practices, direct sowing and transplanting, the latter is by far the more important and it may be said that wherever facilities for transplanting obtain people will prefer it to broadcasting. It would be safer to say that four-fifths of the rice grown in the world is transplanted, and almost all countries like Spain, Italy, Japan, etc., where the highest acre yields are recorded adopt transplanting. Drilling is to a certain extent replacing the practice of transplanting owing to labour difficulties of transplanting as in California. In Italy where also labour is very expensive they have evolved a transplanting machine which can be worked in the puddle.

Broadcasting is usually confined to tracts where the water availability is uncertain and the season is not always dependable. The fact that the yield per acre is definitely higher for a transplanted crop is well recognised though the reason for this increase has not been explained satisfactorily by experimental evidence. It has been sometimes explained that transplanting acts in a way like root pruning; the injury to the root system stimulating the growth of the sub-aerial portion and resulting in increased tillering. It is also stated that transplanting gives a shock to the plant which stimulates better growth and better tillering and consequently better yield. This shock theory cannot, however, be accepted since seeds actually dibbled in lines evenly, yield as much as, if not better than a transplanted crop. In a small-scale experiment conducted some years ago at the Paddy Breeding Station, Coimbatore, comparing actual dibbling with transplanting in the case of two varieties, one a short duration variety, 3½ months, and another a medium duration one, 5 months, the dibbled plots gave decidedly higher yields than the transplanted. Similar results have been obtained in other parts of India and even outside India. If a satisfactory and practical method of actually dibbling the seed directly in the puddled field can be evolved there is no doubt that such a practice should prove an advantage over transplanting. The comparative merits of direct sowing and transplanting have formed the basis of experiments conducted at several of the Departmental Research Stations and the present note deals about such an experiment conducted at the Paddy Breeding Station, Coimbatore, for three seasons 1931—32 to 1933—34.

The Experiment. The experiment was carried out with three strains as shown below:—

Season.	Strain No.	Duration of strain.
1931–32	Co. 1	5 months.
1932–33	Co. 1	5 ,,
,,	Co. 8	6 ,,
1933–34	Co. 9	4 ,,

A row of fields was divided into a number of 2½ cents plots and they were all very uniformly prepared. At the usual time of sowing the nursery, every alternate plot was well levelled and the sprouted seed was sown in it directly as uniformly as possible, and on the same day the nursery for the transplant plots was sown separately. At the time the seedlings were ready they were planted in the alternate plots in the row. The broadcasted plots were not interfered with in the beginning and at the time of transplanting, the plots were given a weeding and the seedlings were thinned out sufficiently so that the number of plants in an unit area was the same in both broadcasted and transplanted plots. At the time of harvesting, the plots were divided each into two equal halves so that the arrangement of the plots was of the A B B A fashion. Each sub-plot was now harvested separately and the yield data analysed statistically.

Besides determining the final yield, the number of plants per unit area (half a square yard), the number of earheads in it, length of the panicles, height of plants, etc., were also recorded from random samples in the different plots so that an explanation could be offered to account for the final yield differences. The sampling was done by putting in an iron ring, half a square yard in area at different spots chosen at random in all the plots and taking notes of the plants inside such rings. All the data obtained are given below.

Year.	1931–32		1932–33				1933–34	
Variety.	Co. 1		Co. 1		Co. 8		Co. 9	
Treatment.	Brord-casted.	Trans-planted.	Broad-casted.	Trans-planted.	Broad-casted.	Trans-planted.	Broad-casted.	Trans-planted.
Yield of grain in lb. of the experimental area—Total of 11 repetitions.	372	392	278	352	221	313	210	288·5
Acre yield in lb.	2,706	2,851	2,022	2,560	1,607	2,276	1,527	2,098
Yield expressed as percentage of mean.	98·6	102·7	88·2	111·7	82·4	119·6	84·0	115·8
Percentage standard error of the mean.	2·6		3·8		3·2		3·0	
Number of ears per unit area (½ sq. yd.).	133 ± 6.6	101 ± 3·24	105 ± 3·60	96 ± 2·25	114 ± 3·22	103 ± 2·01	67 ± 2·61	84 ± 4·45
Mean length of panicle in cms.	—	—	19·0 ± 0·05	20·54 ± 0·06	17·88 ± 0·13	21·07 ± 0·14	20·2 ± 0·09	19·6 ± 0·08
Mean height of plants in inches.	—	—	81·9 ± 0·80	88·4 ± 1·0	82·3 ± 0·84	97·8 ± 0·89	—	—

The season was a bit late in 1931-32 and the plants in the broadcasted plots which were infested by thrips (*Thrips oryzae*) could not make any headway in the early stages. This prevented proper thinning being carried out with the result the number of plants per unit area in the two treatments, broadcasted and transplanted, happened to be different. In the next two years there was no such difficulty experienced, but still the number of plants in the broadcasted plots was slightly more than in the transplanted plots.

Discussion of Results. In 1931—32, the yields of broadcasted and transplanted plots were almost the same. For the reason mentioned previously the broadcasted plot could not be thinned and it had nearly twice the number of plants per unit area as compared to the transplanted crop. The lower population density in the latter was made up by increased tillering. In the second year, the population density was only slightly more in the broadcasted plot in both the varieties, Co. 1 and Co. 8, and still the difference in yield in favour of the transplanted crop has been considerable. Though the number of ears per unit area has been slightly in favour of the broadcasted plots, the individual panicles of the transplanted crop have been definitely bigger in both the varieties, and the bigger ear has been the main cause for the difference in yield. In the trial with the *kar* variety, Co. 9, in 1933—34, the advantage of transplanting has again been brought about. Though it is usually considered that the two treatments cannot make a big difference with regard to short duration rices, under Coimbatore conditions in a normal season, transplanting appears to be better than broadcasting even in a short duration crop. Unlike in the two other varieties, Co. 1 and Co. 8, the increased yield of the transplanted crop in this case has been brought about mainly by the larger number of ears per unit area, the size of the ear in the two treatments not being different.

Other observations. *Root System.* Observations were made on the root system of some plants in the two treatments. It was found that in the broadcasted crop, the plants did not have such a well developed root system as in the transplanted crop. The transplanted plants had a more extensive and deeper root system and this is probably the reason for the broadcasted crop always having the tendency to lodge. In the transplanted crop the tillering and rooting zone is about an inch or two below ground level, and in the broadcasted crop, the seed having been dropped on the surface, the root system is more on the surface and it does not give sufficient anchorage to the plant.

Flowering, duration and height. Though in the experiments the sowing of the seed in the broadcasted plot and the sowing of seed in the nursery for the transplanted crop were done on the same date, the flowering of the transplanted crop was sharp and uniform, while in

the broadcasted crop, it was uneven and delayed. The harvest of the broadcasted crop could be made only a day or two later than the transplanted crop.

In 1932—33 where height measurements were recorded the transplanted crop in both the varieties, Co. 1 and Co. 8, was always taller in growth than the broadcasted crop, the differences between the two being significant. Although no actual weighments of straw yield were made, it was apparent that the quantity of straw was more in the transplanted crop.

Economics of the two treatments. While in the case of the broadcasted crop there is some extra expense due to the higher seed rate used and to the extra weeding that has to be given, in the case of the transplanted crop, the extra expenditure due to the raising of the seedlings and transplanting the same is very much more considerable. As the figures given below show, the value of the increased yield obtained from a transplanted crop not only covers the additional expenditure but leaves a clear extra profit. This net extra profit is about Rs. 14 in the case of Co. 1, Rs. 18—8—0 in the case of Co. 8 and Rs. 8—8—0 in the case of Co. 9 (*kar*).

	Co. 1. lb.	Co. 8. lb.	Co. 9 lb.	
Extra yield of grain per acre due to transplanting.	538	669	571	
	Rs.	Rs.	Rs.	
Value of this extra produce.	19—3—6	23—14—0	13—14—6	
Extra expenses incurred with transplanting.				Rs.
Cost of raising seedlings.				5—0—0
Transplanting charges.				2--4—0
Total.				7—4—0
Extra expenses in the broadcast crop.				
Cost of excess seed.				0-12—0
Cost of one additional weeding and filling gaps.				1—2—0
Total.				1-14—0
Net extra expenses in transplanting over broadcasting.				5—6—0
	5—6—0	5—6—0	5—6—0	
Net profit by transplanting	13-13—6	18—8—0	8—8—6	

Summary. The practice of raising a nursery and transplanting the crop in rice is always preferred to the direct sowing of the seed in the field. That the latter practice still obtains in some tracts is due to the uncertain seasonal conditions and inadequate irrigation facilities.

The comparative merits of the two practices were investigated into by regular experiments at the Paddy Breeding Station, Coimbatore. Three varieties of rice, a short duration *kar* crop, a medium duration *samba* crop, and a long duration *samba* crop were experimented with, and in every case transplanting was definitely found to be very much better than direct sowing. In the *samba* varieties the increased yield was brought about mainly by the bigger size of the earheads in the transplanted crop and in the *kar* crop by the bigger number of earheads per unit area. Even after allowing for the extra expenditure involved in the raising of seedlings and the transplanting of the same, the value of the extra produce obtained in the transplanted crop was enough to leave a clear net profit of Rs. 8 to Rs. 14 per acre.

CROP-CUTTING EXPERIMENTS.

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Introduction. One of the three factors necessary for estimating the yield of a crop, namely the "Standard or Normal yield", is admittedly susceptible of considerable improvement in many Provinces in India. The Agricultural Department in each Province is responsible for fixing the "Normal Yield" per acre for the several crops in each district. The estimate of normal yield is based mainly upon a system of crop-cutting experiments made over a number of years. Under this system, plots of land of average quality are selected in each district by the officers of the Agricultural Department and the crops grown upon them are cut and weighed before them. The results of the experiments are reported to the Director of Agriculture, who on a careful scrutiny of all the reports received by him, and after comparing with such other information as may be available from trade statistics, settlement investigations and the like, fixes the "Standard Yield" of each crop for each district. The estimates are generally revised if necessary at the end of five years.

Reliance on crop-cutting experiments, the methods adopted in carrying them out, and the agency employed in conducting them have all been subjects of criticism in the past. But no satisfactory alternative basis for calculating the normal yield has been suggested. The Board of Agriculture after a very thorough examination of the point in 1919 and 1924 recommended that crop-cutting experiments must remain the basis of estimates of "standard yield". As regards the methods in use, criticism is mainly directed to two points, viz. that the number of experiments are too few to be capable of generalisation over a large area and that they depend for their success entirely on the ability of the officer to select the average field from a large number of fields growing different varieties of a crop at different stages of maturity. In selecting the fields, it is very difficult to give proper weight to