FARM POWER & EQUIPMENT SUB-PROGRAM

REPORT OF WORK

1983

ICRISAT

International Crops Research Institute for the Semi-Arid Tropics
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Farm Power & Equipment Sub-Program

Work Report 1983

Introduction

As a result of further reduction of scientific staff in this sub-program, our research efforts have had to be reduced this year. The sub-program is left with only one Agricultural Engineer and one Research Associate. We had a Post-Doctoral Research Fellow working in the area of tillage who left in February 1983 to join a position at G.B. Pant University of Agriculture and Technology, India. However, research in the area of tillage is continuing with increased multidisciplinary approach.

The research efforts were generally concentrated in the areas of farm machinery design, industrial extension, and field experiments to study the behaviour of soil engaging tool design parameters. In addition to this we were involved in the on-farm vertisol technology research and verification experiments. We conducted eight training programs in cooperation with the scientists from other sub-programs for over 200 participants from various state Departments of Agriculture who are cooperating with us in On-farm studies.

Considerable progress has been made in the development of a mechanical planter during 1983 reporting year. The present design has passed through evaluation stage at the Research Center. A limited number of these machines reached farmers in late 1983. Their performance will be monitored during next rainy season planting operation for on-farm situations. Our efforts to develop low cost planting techniques are continuing.

As a result of some technical support given to small manufacturers two more industries have taken up production of two models of wheeled tool carriers (WTC). There is some indication that the wheeled tool carrier is likely to become cheaper to farmers because of certain competition amongst the manufacturers, who they may also become more aware of quality control in production and customer's satisfaction. Proper understanding of the technical aspects of a tool carrier in terms of its application and utilization for field operations and transportation by farmers, bankers and officials from governmental institutions would also help the propagation of new concept of farming in semi-arid tropical regions. We have started to develop an Operator's manual for wheeled tool carrier. The operator's manual is aimed to be a simple and effective means of communicating to the owner of a wheeled tool carrier the steps to be taken for preparing and adjusting his machine for an intended operation.

Looking Ahead

We plan to continue field experiments on interrow weed management and fertilizer placement. Results from these experiments will help in improving designs of some of the existing machinery components. We are aiming to develop a four-row planter unit which can be used independent of a wheeled tool carrier. This development will particularly help those farmers who wish to improve upon planting techniques but do not intend to purchase a tool carrier.

Considerably more efforts will be made now to develop spraying and dusting equipment for tall crops especially pigeonpea. This work will involve evaluation of various technological options and pesticide formulations in the laboratory as well as in field studies.

A study of performance and implications of improved animal drawn equipment in on-farm situations will continue. This area of research will help us in making a near ultimate test of improved machinery systems developed to assist SAT farmers, and identifying areas of further research and development.

Planter Development

Development of a four-row mechanical planter and fertilizer drill began 2 years ago (1980/81 ICRISAT Annual Report). Prior to that, a fertilizer drill based on an oscillatory metering principle was developed. Problems of seed metering and its placement were resolved in the past year (1982 ICRISAT Annual Report). During this reporting year seed and fertilizer metering units, power transmission system and furrow openers were put together on the Tropicultor and the Nikart for rigorous testing and performance evaluation. A few design modifications on clutch, seed metering plate and its driving arrangement were also made during the course of evaluation.

Present design of a four-row planter and fertilizer drill shown in figure 1 can be used with the Nikart or the Tropicultor as an attachment. Only mounting frames are different in its use with two models of WTC. The planter mounting is slightly different on the two WTCs. However in both the cases metering systems receive power from left wheel of the WTC. A hand lever operated clutch is provided to disengage power when desired. Fertilizer application rate is controlled by varying the amplitude of oscillation of a trough. A connecting rod giving the oscillatory motion to the trough is actuated by a cam having eight holes at different radii. By moving a connecting rod from one hole to another the amplitude can be varied in eight steps which in turn, gives eight possible fertilizer application rates. Seed is metered by inclined metering plate. Fertilizer and seed descend to the furrow openers through respective telescopic tubes. The furrow openers are supported on the toolbar of WTC. These can be raised above ground level for transport position. Fertilizer is placed 4 cm away from and below the seed and seed is covered and compacted by floating soil deflectors and a press wheel.

The planter was successfully used for planting monocrops as well as intercrops. It gave a good control on seed rate as desired for a particular crop. There was no need of seed rate calibration in the field and the information provided on metering plate selection was adequate. However, in the case of fertilizer, actual application rate varied from the expected rate for a particular adjustment position. This deviation was attributed to variations in the manufacturing dimensions from one machine to another and consistency of the fertilizer itself.

It was observed that upto three row planting with double shoe furrow opener was not a problem for an average size pair of bullocks (Table 1). For planting four rows at a time in a well cultivated soil,

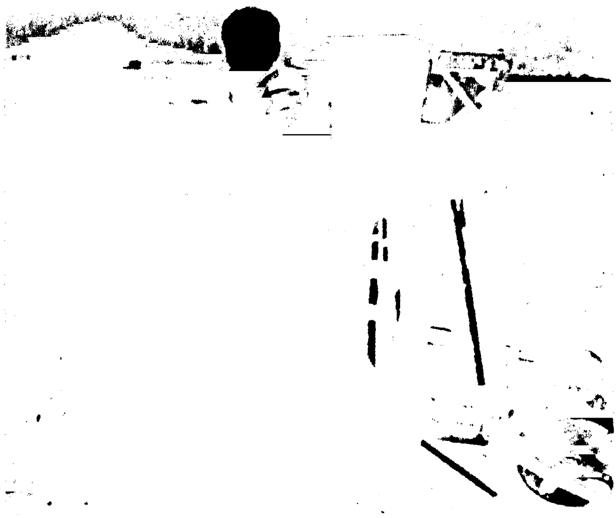

Figure 1: A four-row planter and fertilizer drill mounted on the Tropicultor.

Table 1: Pull requirement for planting and fertilizer application.

Soil type	Crop	No. of rows per pass	Pull (kg) Range	Mean	CV (%)
Vertisol	Maize	2	90 - 140	108	11
Vertisol	Sorghum/pigeonpea	3	140 - 170	147	6
Alfisol	Millet	3	100 - 140	124	13
Alfisol	Cowpea	4	130 - 170	153	8

a pair of bullocks could also pull the machine easily. However, for planting four rows of a post-rainy season crop in Vertisols the operation was strenuous and farmers complained about high draft. Thus some more work on the design of furrow opener is necessary to reduce the draft requirement.

Farmers' reaction to the planter was generally favorable as the plant stand obtained with it was distinctly superior to local equipment. Performance results at ICRISAT watersheds show that this machine takes 4-6 hours to cover 1 ha depending upon plot size and shape and other operational factors (Table 2). As a comparison, in farmers' fields in Gulbarga district of Karnataka State, India, hand sowing with traditional equipment required on an average 10.2 h/ha for groundnut or sesamum (sesamum indicum L.) intercropped with pigeonpea. The mechanical planter on the other hand required only 4.4 h/ha for the same crops, which represented a 57% saving in time.

Table 2: Actual field capacity for planting and fertilizer application on different land management practices.

Watershed No.	Soil type	Surface configration	Crop	Machine (h/ha)	A.C* (ha/h)
BW5A	Vertisol	BBF**	Maize	5.4	0.18
RW3D	Alfisol	BBF	Sorghum/ pigeonpea	4.0	0.25
RW3D	Alfisol	BBF	Millet/ pigeonpea	4.7	0.21
RW3D	Alfisol	BBF	Castor/mung	3.9	0.26
RW3B	Alfisol	Flat	Sorghum/ pigeonpea	4.6	0.21
RW3B	Alfisol	Flat	Millet/ pigeonpea	5.0	0.2
RW3B	Alfisol	Flat	Castor/mung	3.9	0.26
			Average	4.5	0.22

* AFC - Actual field capacity (ha/h).

** BBF - Broadbed and furrow system.

Fertilizer Placement Experiment

It is generally believed that 4 to 5 cm separation between seed and fertilizer at the time of sowing is essential for the safety of tender seedlings. However, there is some evidence from a preliminary study at ICRISAT that this separation is not necessary in the case of Vertisols, because of high soil moisture at the time of germination and emergence. An experiment was started this year to quantify the effects of fertilizer placement with respect to seed because of their implication on furrow opener design.

A split-split plot design was adopted for this experiment conducted on a Vertisol watershed during the rainy season with sorghum CSH-6 as a test crop. The experiment had following treatments.

A. Main plot - fertilizer placement (3 levels)
   P1 - Half dose of recommended N applied along the seed row.
   P2 - Half dose of recommended N 4 cm to the side and below the seed.
   P3 - Half dose of recommended N given along the seed row + remaining half from urea placed at 10 cm to the side and below the seed.

Thus, in treatments P1 and P2 only half N was given as basal, and remaining portion was side dressed. But in the case of P3 full amount of N was placed at the time of planting.

B. Sub plot - types of fertilizer for basal application (3 levels).
   F1 - Diammonium phosphate, 18-46-0.
   F2 - Ammonium phosphate, 28-28-0.
   F3 - Nitrophosphate, 20-20-0.

C. Sub-sub plot - Total N (2 levels)
   N1 - 40 kg N/ha.
   N2 - 80 kg N/ha.

The experiment had three replications as shown in figure 2. Some area adjoining to each block was sown as a control plot with the same crop without any fertilizer to see the N response.

All the operations in the field were done by using WTC. Planting and fertilizer application was done by using a four-row planter attachment to the WTC. Each plot (6 x 4.5 sq.m) had 9 rows of sorghum. To obtain desired placement of fertilizer with respect to seed suitable furrow openers were designed and the fertilizer drill was precalibrated to obtain the desired dose within $\pm 10\%$. Planting in entire experimental area was completed in two days.

Results of plant height measurement are summarised in Tables 3 and 4. Fertilizer placement treatments did not show any significant differences at any stage indicating that the mixing of fertilizer with sorghum seed did not have any adverse effect. Fertilizer type actually showed some difference. Plots in which diammonium phosphate was applied tended to show faster growth. However, the differences were not significant at 5% probability. Interaction of placement with fertilizer type was also non-significant.

The two levels of fertilizer(N1 and N2) had marked differences in yield. The crop in zero N area in the control plot outside experimental blocks was very poor. The interaction of dose with placement was not significant at 5% probability, which indicates that upto 80 kg N/ha from any of the three sources used in the experiment is safe when placed along with sorghum seed in Vertisol. However, due to some difficulties in carrying out operations with the WTC in this small plot experiment, the results can be taken only as indicative. This experiment will be repeated with bigger plot size.

1. MAIN PLOT - Placement
   P1 - Seed row;
   P2 - side and below 4 cm.
   P3 - Basal seed row + top dress urea side and below 10 cm.
2. SUB PLOT - Fertilizer types
   F1 - DAP,
   F2 - 28:28:0
   F3 - 20:20:0
3. SUB-SUB PLOT - DOSE
   N1 - 40 kg N/ha
   N2 - 80 kg N/ha

Block I

F3N1 P2	F3N2 P2	P2 F1N1	P2 F1N2	F2N1 P2	F2N2 P2
F3N1 P3	F3N2 P3	F2N1 P3	F2N2 P3	F1N1 P3	F1N2 P3
F2N1 P1	F2N2 P1	P1 F3N1	P1 F3N2	F1N1 P1	F1N2 P1

Block II

F2N1 P3	F2N2 P3	F3N1 P3	F3N2 P3	F1N1 P3	F1N2 P3
F3N1 P2	F3N2 P2	F1N1 P2	F1N2 P2	F2N1 P2	P2N2 P2
F1N1 P1	F1N2 P1	P1 F3N1	P1 F3N2	F2N1 P1	F2N2 P1

Block III

F1N1 P2	F3N1 P1	F2N1 P3
F1N2 P2	F3N2 P1	F2N2 P3
F3N1 P2	F1N1 P1	F1N1 P3
F3N2 P2	F1N2 P1	F1N2 P3
F2N1 P2	F2N1 P1	F3N1 P3
F2N2 P2	F2N2 P1	F3N2 P3

Figure 2: LAYOUT OF FERTILIZER PLACEMENT EXPERIMENT   LOCATION BW6C

Table 3 : Effect of fertilizer treatments on sorghum plant height at the third week after sowing.

Placement / Fertilizer type	Dose (kg N/ha)	Seed row	Side and away	Basal at seed row + urea	Mean height for each fertilizer used	SE
		------------- plant height cm -------------				
18-46-0	40	10.0	8.6	11.7		
	80	13.1	11.4	12.2	11.2	±0.35
28-28-0	40	8.7	9.7	7.7		
	80	9.2	9.7	9.7	9.1	
20-20-0	40	10.7	8.4	8.0		
	80	11.0	11.7	11.6	10.2	
Mean height for different placement method		10.5	9.9	10.2		
SE			±0.31			

Mean height at 40 kg N/ha = 9.3

Mean height at 80 kg N/ha = 11.1

SE ±0.26

Table 4 : Effect of fertilizer treatments on sorghum plant height at eight weeks after sowing.

Placement / Fertilizer type	Dose (kg N/ha)	Seed row	Side and away	Basal at seed row + urea	Mean height for each fertilizer used	SE
		---------------plant height cm---------------				
18-46-0	40	110.5	129.9	127.9	130.2	±3.4
	80	129.7	142.9	140.5		
28-28-0	40	106.7	120.9	110.0	118.9	
	80	128.4	130.4	115.9		
20-20-0	40	106.7	104.5	108.8	119.9	
	80	127.7	126.6	139.7		

Mean height for different placement method		119.2	125.9	124.0
SE			±6.2	
Mean height at 40 kg N/ha	=	114.7		
Mean height at 80 kg N/ha		131.3		
SE		±2.1		

Mechanical Management of Weeds

Interrow weed management in rainy season crops is difficult because of unfavorable soil conditions. In the past it has been found that some implements like the blade hoe appear to cut weeds better than duckfoot shovels. But even with the blade hoe, weeds are not fully damaged and some of them reestablished within a short while. An experiment on mechanical control of interrow weeds was started to evaluate available implements for their relative performance. It was conducted on a Vertisol watershed, BW-5B, during the rainy season using sole maize and sorghum/pigeonpea intercrop. However, due to poor stand of sorghum, the sorghum/pigeonpea trial was abandoned this year. This experiment was done in a randomized block design and had the following treatments for interrow cultivation.

T1 - Pre-emergence herbicide and blade hoe,
T2 - Blade hoe alone,
T3 - A combination of blade hoe and duckfoot sweeps in one pass,
T4 - Runner blades,
T5 - Rod weeder,
T6 - Farmers practice with no hand weeding,
T7 - Farmers practice with one hand weeding,
T8 - Control (weed free).

There were three replications. The crop was grown on broadbeds using WTC for all the operations upto planting and fertilizer application. Interrow cultivation was done twice during the vegetative phase by using different implements as assigned to the treatments. Once again WTC was utilized for treatments T1 to T5. For the maize crop grown at 75 cm row spacing, 50 cm wide blade hoe was used in T1 and T2 plots. In T3 plots two 20 cm wide duckfoot sweeps were mounted on a steerable toolbar behind the blade hoe. Thus in this treatment weeds cut by blade hoe were further distributed by the sweeps. T4 had left hand and right hand runners. Free space between the runners was covered by one duckfoot sweep. A 60 cm wide rod weeder was developed for trial as treatment T5. In treatments T6 and T7 traditional interrow cultivation equipment called a bakhar was used.

Effectiveness of interrow cultivation treatment was measured by hand picking weeds surviving two days after the operation, from 1 sq.m area. These weeds were then oven dried and weighed. Dry matter weight of weeds is presented in figure 3.

For the first interrow cultivation done on 14 July 1983, the differences in the treatments was found to be significant. Treatments of pre-emergence herbicide and blade hoe (T1) and intensive operations with blade hoe combined with duckfoot sweeps (T3) gave equal performance which was superior to other treatments. It was observed that sweeps working behind the blade hoe destroyed already cut weeds quite well and reduced their chances of reestablishment. Cultivation with only the blade hoe (T2) was marginally better than remaining treatments (T4, T5, T6, and T7). As no hand weeding was done in treatments T1 to T6 after the first interrow cultivation, the same pattern of weed intensity that was observed earlier was noted at the second interrow cultivation. At this stage, however, differences in weed dry matter weight between treatments were not significant at 5% probability. Actual weed intensity in various treatments affected the yield significantly and poor weed management especially during the early stages of crop establishment reduced yields considerably (Figure 4).

Evaluation of Different Planting Methods

The development of different ox drawn planting equipment at ICRISAT has gone through many stages in past few years. Until recently when a four-row planter and fertilizer drill was not available, Ebra seeders either individually driven by press wheels or a group of four units powered from a common shaft were used. In addition to the development of a four-row mechanical planter, we have also made some progress on low cost equipment. The low cost options include a gravity flow metering unit using Planet Jr. concept, and a hand metering system adopted to WTC. It was then felt necessary to study the comparative performance of all the available equipment for planting in a replicated experiment.

This experiment had started in 1982 in a Vertisol watershed BW-4A. First year's results on this experiment, reported in ICRISAT Annual Report 1982, indicated that the yield is not significantly affected by differences in mean spacing, variance, and CV due to planting mechanisms. During 1983

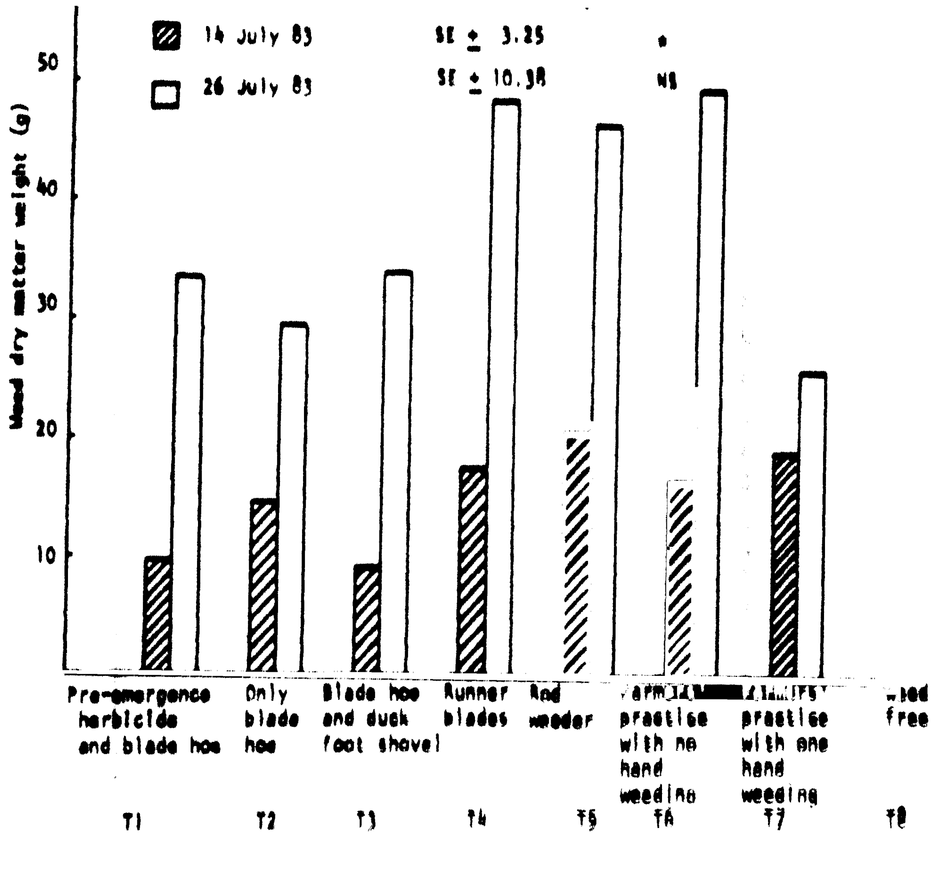

Figure 3 : Dry matter weight of weeds remaining after interrow cultivation operation.

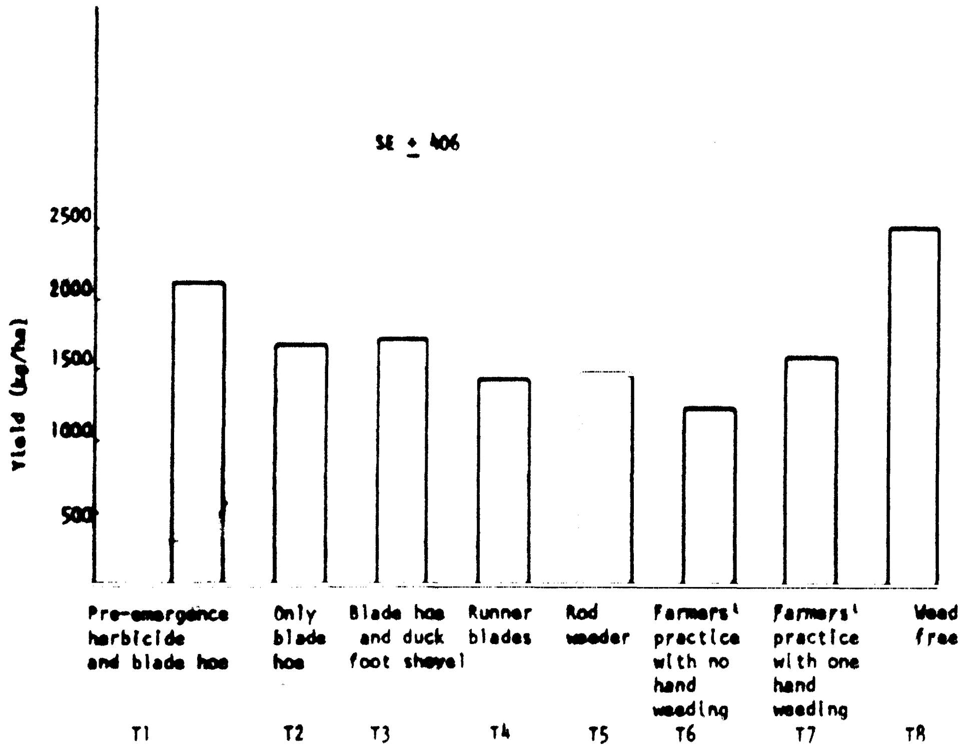

Figure 4: Maize yield from interrow cultivation experiment.

the same experiment was continued and data on chickpea (Annegiri) Maize (Deccan Hybrid-101) and sorghum (CSH-6) was collected. Chickpea was planted using five methods whereas maize and sorghum were planted using six methods. A treatment (T5) was added to find out the feasibility of hand metering system on tool carrier. The treatments were as follows:

T1 - Ebra inclined plate unit planter driven by the press wheel.

T2 - Ebra inclined plate unit planter mounted on the tool carrier frame and driven by common shaft.

T3 - Locally designed, inclined plate planter mounted on the tool carrier frame and driven by a common shaft.

T4 - Locally designed low cost seeder based on Planet Jr. system with wooden divider.

T5 - Hand metering system mounted on tool carrier.

T6 - Local seed drill (Gorru).

Planting of all the crops was done on broadbed and furrow of 1.5 m width. Each plot consisted of three broadbeds of 10 m length. Basal dose of fertilizer was applied separately before planting, by using oscillatory fertilizer drill in all treatments. All the planters were calibrated in the field to achieve optimum plant stand before planting. Calibrations of planters showed that the six planting methods could not give equal seed rate: an important factor determining plant to plant spacing (Table 5). In order to minimise the variability in seed rate from hand metering, weighed quantity of seed for each bed (10 m length) was given to the operator. Furthermore, in order to avoid differences in row-to-row spacing, the local seed drill (Gorru) was specially made to maintain uniformity between treatments. Seed rates from planters T1, T2, and T3 were slightly different due to variations in metering plates and their turning speed.

The mtthods of analysis were considered appropriate for evaluating the planters. The first was to plot histograms and indicate the percentage of plants with spacing within a optimum range. The optimum range is considered between 0.5 to 1.5 times the theoretical mean spacing which is 20 cm for maize, 10 cm for sorghum and 8 cm for chickpea. Hence optimum spacing ranges for maize, sorghum and chickpea are 10-30 cm, 5-15 cm, and 4-12 cm respectively. The second method compares the mean spacing and coefficient of variance obtained from different planters.

Table 5: Effect of type of planting equipment on establishment and yield of maize and sorghum on Vertisols, 1983.

Crop	Planting equipment	Seeding rate (no/15m^2)	Mean spacing between plants (cm)	Yield (kg/ha)
Maize	T1 Ebra, press wheel drive	160	21	3095
	T2 Ebra, common shaft drive	140	22	3785
	T3 Local, common shaft drive	140	20	4010
	T4 Modified low cost seeder	160	23	3045
	T5 Hand metering with tool carrier	120	26	3050
	T6 Local seed drill	120	25	3110
	SE		±0.8	±322.1
Sorghum	T1 Ebra, press wheel drive	360	25	2235
	T2 Ebra, common shaft drive	390	23	2150
	T3 Local, common shaft drive	360	24	1850
	T4 Modified low cost seeder	360	24	1730
	T5 Hand metering with tool carrier	330	24	1975
	T6 Local seed drill	330	27	995
	SE		±2.1	±224.1
Chickpea	T1 Ebra press wheel drive	560	11	480
	T2 Ebra common shaft drive	600	10	535
	T3 Local common shaft drive	640	13	515
	T4 Modified low cost seeder	640	18	500
	T5 Local seed drill (Gorru)	440	14	445
	SE		±1.3	±109.

Plant population histograms for various crops are presented in figures 5 to 7. The results indicate that the Ebra planter driven by press wheel (T1) gave maximum number of maize plants (69%) in an optimum range, which was closely followed by locally designed common shaft driven planter (T3). The performance of the other four methods was similar to each other. The advantage of the Ebra planter (T1) was probably because it has the smallest vertical drop of about 30 cm for the seed compared to other treatments. The vertical drop of seed from the metering unit to the furrow opener for treatments T2 to T5 varied between 1 m to 1.5 m. This factor could have affected the distribution pattern of maize seeds.

In the case of sorghum and chickpea vertical drop of seed does not appear to have any effect on the distribution pattern. It could be due to high intra-row plant density. The modified low cost seeder (T4) gave a marginally superior performance over all other treatments, however, the differences are small.

Analysis of variance for maize showed significant differences ($P < 0.05$) between treatments for mean plant to plant spacing. But the plant population and yield of maize were statistically non-significant ($P < 0.05$) which confirm the first year's result that the variability obtained in intra-row spacings from different planting techniques does not affect maize yield.

Analysis of variance for sorghum showed a non-significant difference ($P<0.05$) for mean plant to plant spacing, and a significant difference in plant stand. The plant stand and yield obtained from the local seed drill was about half that of other treatments. This could be due to no seed covering and compaction of the soil.

Analysis of variance for chickpea showed a significant difference ($P < 0.05$) for mean plant to plant spacing and plant stand, but non-significant difference in the yield from five treatments.

It can be concluded from this experiment that the hand metering system can be as effective as a mechanical planter, provided placement and coverage is improved. In this case a weighed quantity of seed was used by the operator, metering seed by hand for each row. However, in a farmer's situation, skill of the operator can be very important in determining the intra-row plant spacings. It appears that low cost planting techniques

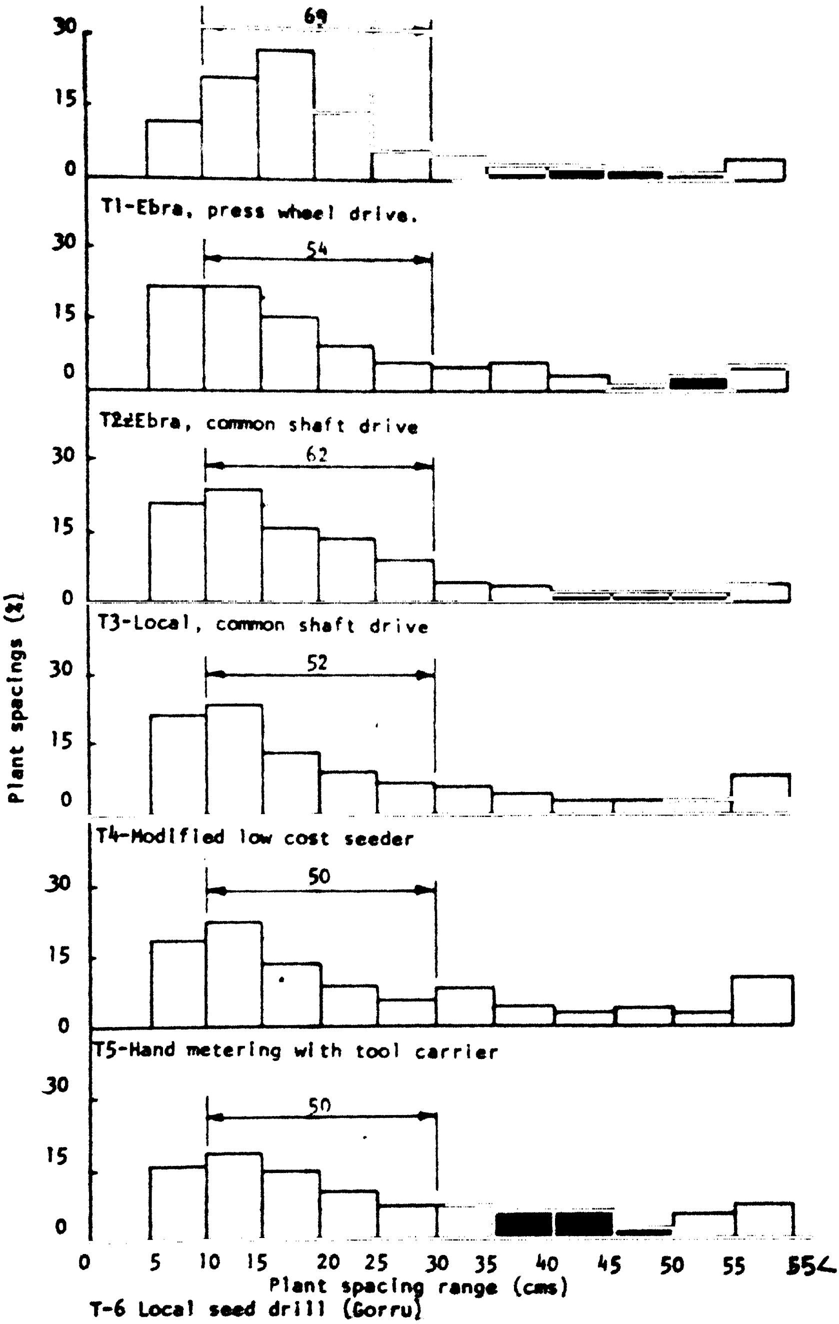

Figure 5 : Percent of plants established in various spacing ranges for maize, planted by six different planters (1983).

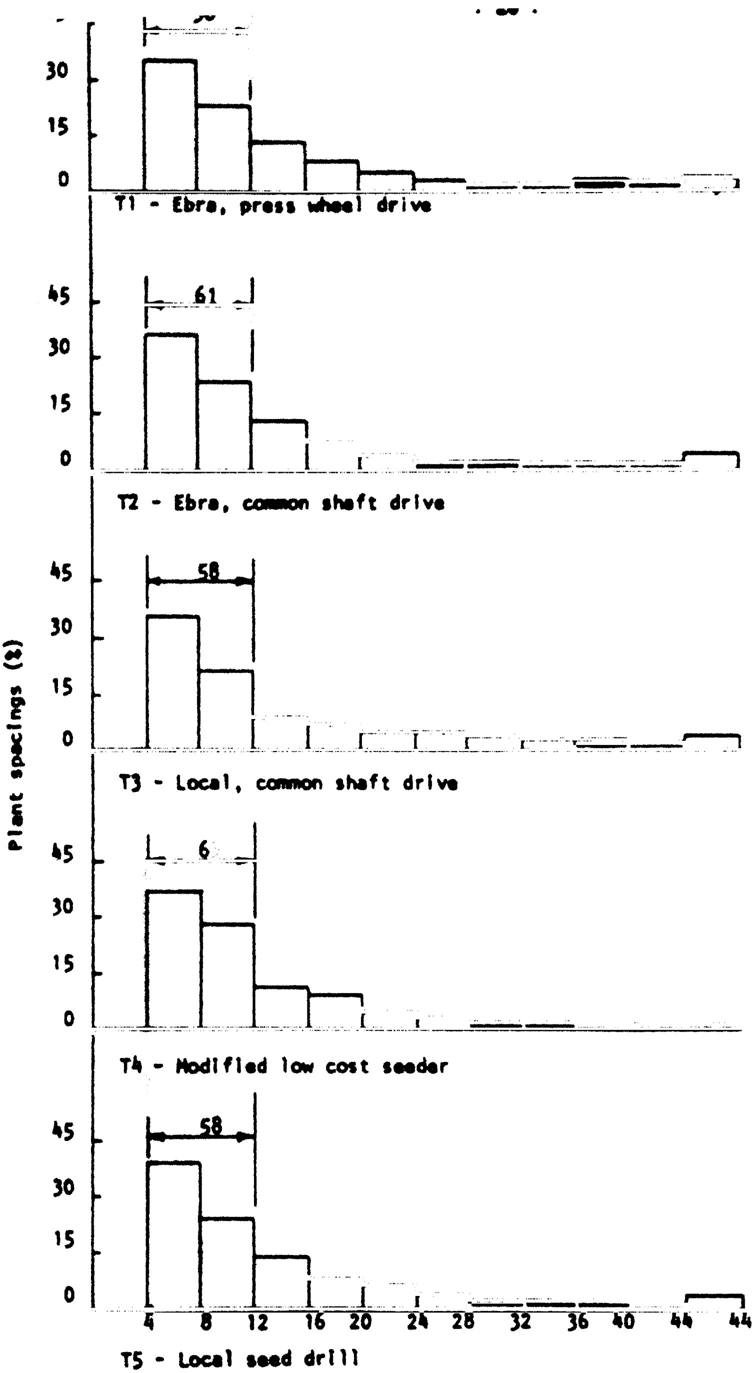

Figure: 7 : Percent of plants established in various spacing ranges for Chickpea, planted by five different planters (1983).

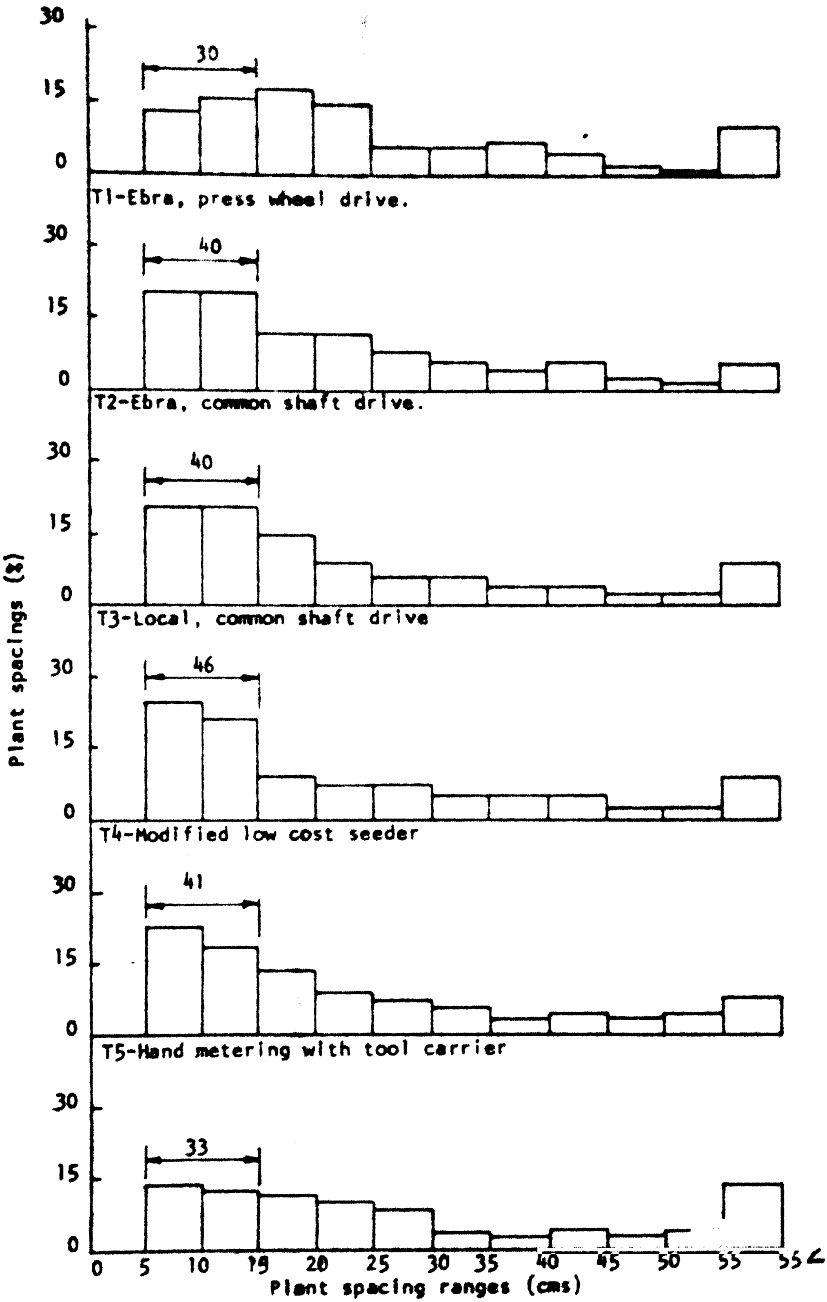

Figure:6: Percent of plants established in various spacing ranges for sorghum planted by six different planters (1983).

can be successfully used with wheeled tool carriers. These systems needed to be developed and tested on larger plots.

Support to Manufacturers of Improved Equipment

Technical support to a few manufacturers of improved equipment in India has been taken up to ensure the availability of the equipment to the farmers from local sources. This activity also assists the establishment of multilocational sites for on-farm verification of improved technologies by making necessary equipment available. In the process, Farm Machinery research at ICRISAT, obtains feed back of improved designs from the eventual users.

Schematic representation of our support to the manufacturers is given in figure 8. Assistance to the manufacturers from ICRISAT is generally limited to design drawings and training. The interested manufacturers receive engineering drawings of well tested designs of equipment. Some of their technical staff often visit ICRISAT to actually see the working of a new design before making a prototype. When the prototype is ready it may be seen by ICRISAT engineers to assess the quality of workmanship and to offer suggestions if necessary.

A few representatives from manufacturers received training at ICRISAT from time to time so that they can provide effective demonstration and after sales service to the farmers. ICRISAT has no direct interest or involvement in the production process and sales methodology adopted by any manufacturer. However, from time to time, we organize training and group discussion involving staff from extension agencies, manufacturers and scientists to exchange information on new developments and users' experience.

Technical cooperation between ICRISAT and small industries in India began as early as 1979. Several industries had shown interest in WTC and implements, but until 1982 only two companies retained continuous interest in manufacturing and marketing of this equipment. A major reason for this could be the low rate of growth of the market for such machinery. The WTC is very different in its use and maintenance compared to traditional ox-drawn implements. Thus the introductory stage had been slow, and the demand was well below 100 machines per year (Figure 9). Most of these machines were purchased by research institutions. However, due to promising results from on-farm Vertisol technology verification experiments and general awareness on the usefulness of improved animal drawn machinery system,

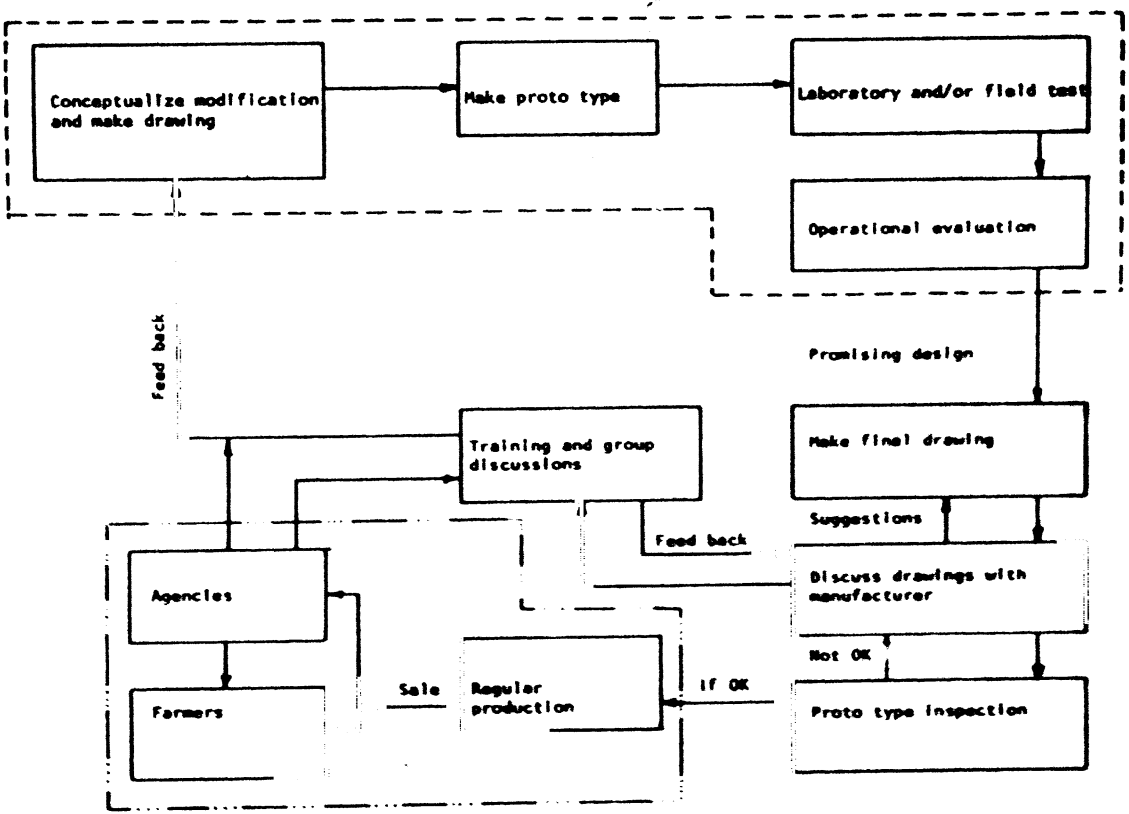

Figure 8: Technical support to manufacturers - a schematic presentation.

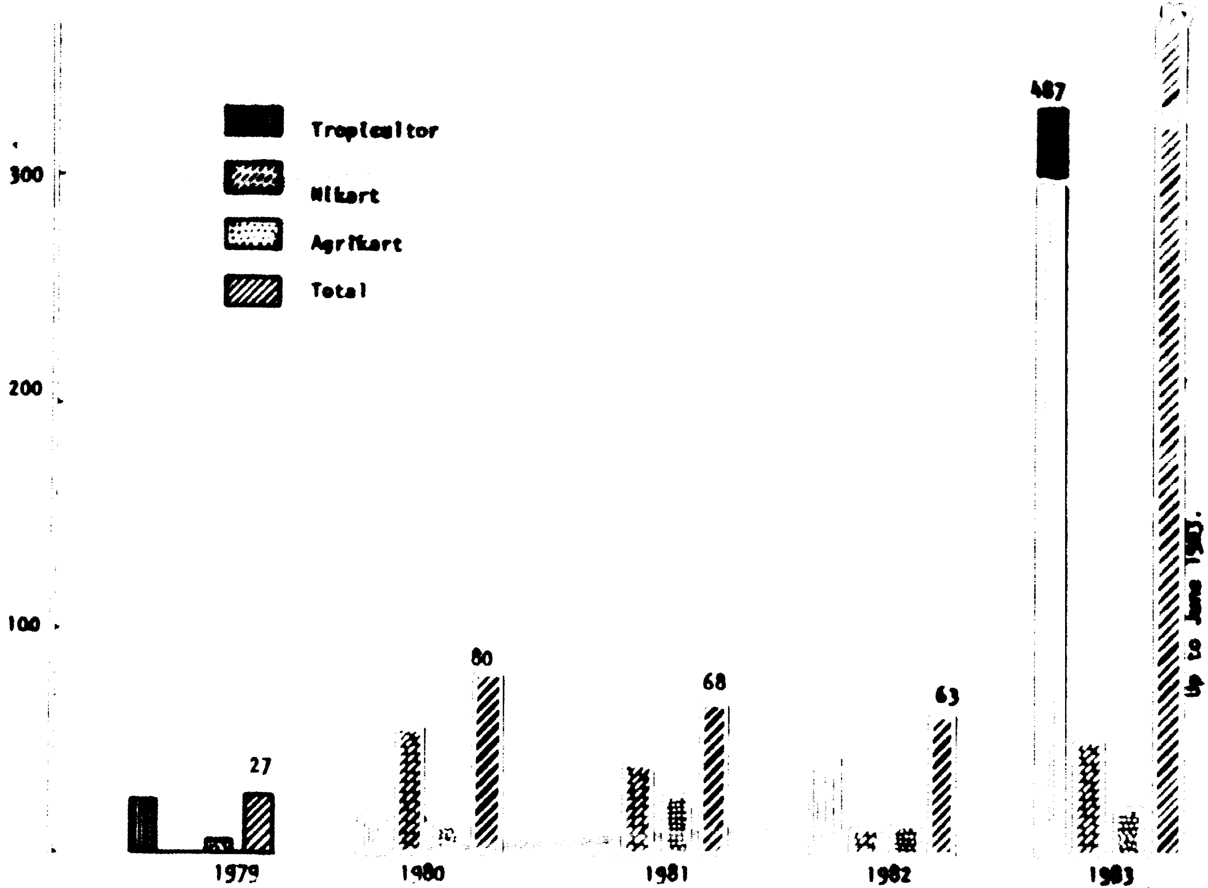

Figure 9: Production of wheeled tool carriers in India.

the WTC is now better accepted by Government extension agencies and farmers. The sale of the WTC suddenly increased several fold in first half of year 1983 as a result of price support from Governments in some states and these machines are being used by farmers for cultivation as well as transport purposes.

Improved animal drawn equipment appear to be doing well under farmers conditions specially where new farming systems are also showing positive results. Constraints of high initial cost and manufacturing quality are still there. Some of these problems can be resolved by promoting greater awareness in the manufacturers towards quality and a healthy competition among them. At present there are four small manufacturers at different locations in India, producing three models of the WTC along with a full range of implements.

Farm Power & Equipment - Staff List

Mr. G.E. Thierstein	Principal Agricultural Engineer.
Dr. T. Takenaga	Principal Agricultural Engineer (Since Nov 1983).
Mr. R.K. Bansal	Agricultural Engineer
Mr. V.M. Mayande	Asst. Agrl. Engineer
Mr. K. Tippanna	Research Associate I
Mr. M.M. Babu	Draughtsman
Mr. N.P. Thomas	Sr. Fitter/Welder
Mr. C.R. Ross	Asst. Fitter/Welder
Mr. R. Gnaneshwar	Asst. Fitter/Welder
Mr. B.N. Chari	Asst. Fitter/Welder
Mr. Khaja Azeemuddin	Asst. Turner
Mr. Iqbal Ahmed	Field Assistant
Mr. R. Aseervadam	Field Assistant
Mr. S. Kutty	Field Attendant
Mr. M. Azeemuddin	Driver-cum-Gen. Asst.
Mr. S. Ramachandran	Secretary