A TECHNICAL EVALUATION OF IMPROVED ANIMAL DRAWN IMPLEMENTS UNDER ON-FARM CONDITIONS[a]

by

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ABSTRACT

Animals are a major source of agricultural power in India and animal drawn implements have evolved to a high degree of simplicity and perfection over a long period of time. A comparison is made between some improved machinery and the traditional machinery in terms of field capacity and draft, using on-farm data. It is shown that the field capacity of the improved machinery is usually higher than the traditional machinery and that total draft might be higher or lower depending on the particular operation.

INTRODUCTION

Animals are the chief source of power in Indian agriculture with more than 64% of the energy input in farming originating from animal sources. This bullock power resource in India is extremely valuable and it is important that it be used to the fullest extent (Subrahamanyam and Ryan 1975). Many implements using animal energy as motive power have evolved to a high degree of simplicity and perfection over thousands of years (Ramaswamy 1978). Emphasis on the development of animal drawn machines and implements is given to better utilise the abundantly available animal power and also to improve the machinery for timely completion of tillage operations needed to increase and stabilize crop yields to meet the growing food demand of increasing population.

In the late 1950s and early 1960s considerable efforts were being put into the development of animal drawn wheeled tool carriers (ADT). The ADT is a frame with two wheels to which a large range of implements can be attached. The frame provides horizontal and vertical stability to the implements, some means of depth adjustment of the implement, and a mechanical device for lifting the implement for transport or lowering it into the working position. This concept never became popular due to mechanical

problems in the designs and the low cost of fuel which favored the introduction of tractors. In recent years there has been a trend to re-examine the ADT particularly for use in dryland agriculture where yields are generally quite low.

The performance of the wheeled tool carrier and its attachments has been very encouraging in terms of improvement in timeliness and precision of operations. Working with traditional implements is often strenuous and associated with very low rates of work output (Bansal and Shrivastava, 1981). The conventional animal drawn machines available in India consist of a desi (wooden) plow, bukhar (blade harrow) and Tipan (seeder) with three wooden furrow openers and a funnel into which seed is metered by hand (Thierstein 1979). The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Indian Council of Agricultural Research (ICAR), agricultural universities in India, and many private entrapreneurs are placing considerable emphasis on the design and development of farm machinery.

ON-FARM RESEARCH NEEDS

Researchers are convinced that the impact of new designs of machines is measured not solely by its performance at research stations but more importantly by the extent to which it is adopted by farmers. A close working relationship between researchers and farmers, which permits farmers' agroclimatic and socio-economic environments to influence the new designs and performance is considered an important ingredient of the farm machinery research in farming systems program at ICRISAT and All India Coordinated Research Project in Dryland Agriculture (AICRPDA).

ON FARM RESEARCH

AICRPDA and ICRISAT have been involved since 1978 in a cooperative on-farm research project on farming systems in three villages - Aurupalle, Kanzara, Shirapur, and since 1981 in Taddanpally in different agroclimatic and socio-economic sub-regions of Central Peninsular India. In Taddanpally the cooperation is through the Andhra Pradesh Department of Agriculture.

An informal collaboration between AICRPDA and ICRISAT on testing of traditional and improved implements at Chcutkur village in Medak district was started in August 1981. Some important agroclimatic and socio-economic characteristics of these five villages are given in Table 1.

Small scale replicated experiments which consisted of using the ADT on a broadbed and furrow (B/F) and on a flat land management, and traditional implements on flat management systems with three cropping systems were started in 1978-79 at Shirapur, Kanzara, and Aurepalle villages to obtain preliminary information at all three locations, involving one farmer at each village. The three treatments permit the testing of two distinct concepts. In the first instance a package of improved machinery was compared against a package of traditional machinery. In the second instance the package of improved machinery has been compared under two land management systems.

The first management system uses a traditional flat cultivation system in which operations are done on or near the contour. In the second management system a bed and furrow system is used. The second system provides distinct traffic zones and cropping zones. Operational scale watershed based experiments on soil and water management and cropping systems using the ADT began in 1979, in all three villages. Similar operational scale watershed based research was started at Taddanpally village in Medak district in 1981, as a collaborative project between AICRPDA - Andhra Pradesh Agricultural University (APAU) - ICRISAT - A.P. Department of Agriculture.

OBJECTIVES OF ON-FARM RESEARCH

1. To test, adapt, and measure the performance of the prospective farming systems technology on farmers' fields.
2. To involve farmers in the technology development process and to identify appropriate forms of group action among farmers for adoption of watershed based system of resource development and management
3. To assess the economic and technical performance and farmers' acceptability of the "improved" machinery and management systems compared to the "traditional" systems.

4. To monitor the rate of adoption and impact of new technology and to gather feedback information on the research requirements for specific components of farming systems technology.

In this paper we are considering only the technical performance of machinery systems.

DESCRIPTION OF THE TOOL CARRIERS USED

i) Tropicultor. This ADT is an intermediate unit between the power source, i.e. a pair of bullocks and the implement. The unit weighs about 200 kg and consists of a steel frame chasis carried on two pneumatic tires. The bullocks are hitched to the frame through a beam with a yoke. The horizontal angle of beam can be adjusted to eliminate the effect of animal height upon the working angle of the implement. At the rear of the tool carrier is a 170 cm long toolbar on which a range of implements such as plows, ridgers, cultivation tools, fertilizer applicator, planters etc, can be mounted with simple U-clamps. A mechanical lifting mechanism facilitates the raising of the implements for turning and transport.

ii) Agrikart. The design is basically similar to the Tropicultor with some modifications in material and construction methods. The main frame of the Agrikart is made out of steel channels.

iii) Agribar. This low cost toolbar is a simple 'T' bar having a beam and over center lift mechanism. The horizontal beam angle adjustment is done by shortening or lengthening the telescopic link at the center. Guide wheels are clamped at both ends of toolbar and are also used for depth adjustment by sliding the wheel shank in the 'U' clamps.

METHODOLOGY

1. On-farm study villages. The actual field capacities and total bullock hours to complete the different operations in three machinery/management systems at Aurupalle in 1978 79 are given in Table 2. The time required to complete each operation on each plot was recorded for the Tropicultor on a B/F system, Tropicultor on the flat, and traditional implements on the flat.

The Tropicultor operations on the B/P include chiseling, strip moldboard plowing, ridging, cultivation with duckfoot sweeps, bed forming, planting with inclined plate unit planters and interrow cultivation. The traditional operations are plowing with the desi plow, bukharing, sowing with the Tipon, seed covering with a plank, and interrow cultivation with a local hoe.

The data on traditional operations at Aurupalle, Shirapur, and Kanzara village for average human and bullock labor hours per hectare for growing major crops is given in Table 3. The data represented is an average of three years from 1975-76 to 1977-78. The human and bullock labor use per hectare for 1979-80 watershed experiment using the Tropicultor at Aurupalle, Kanzara and Shirapur is given in Table 4.

Table 5 provides a comparison between the field capacities achieved with ADTs in an on-farm situation compared to that achieved at the ICRISAT Center.

2. Choutkur Village. The following machinery was tested at Choutkur village.

a) Traditional:	Plow, blade harrow and gorru.
*b) Improved traditional	Fertilizer attachment to gorru.
&c) Agribar:	Sweeps.
&d) Agrikart:	Plow, one meter blade harrow, and seeding (hand metering).

A telescopic beam was attached to the Agrikart and traditional implements for recording draft with a mechanical dynamometer. The arrangement for attaching the dynamometer in the Agribar was done with rollers and a rope tied to the yoke.

Soil samples were taken at the time of each operation to determine the soil moisture condition which is an important factor affecting the draft. The observations on the draft requirement, depth of operation, theoritical and actual width of coverage and time required were recorded. The field

*These implements were developed by AICRPDA.

&These items were supplied for testing by Medak Agricultural Centre.

capacities and bullock pair hours for plowing and cultivation operation are given in Tables 6 and 7 respectively. The draft given in the table is an average of several readings taken in the field. The depth of operation was measured with a depth gauge. The actual field capacity (AFC) is calculated by the following formula.

$$AFC\ (ha/hr) = \frac{Area\ covered\ in\ hectares}{Time\ required\ in\ hours}$$

RESULTS AND DISCUSSION

1) On-farm study villages: The number and type of operations required depends upon the system of management (Table 2). The three systems compared at Aurupalle shows that flat management needed six operations and the B/F system of management nine operations. Though there were more operations on the B/F system, the bullock pair hour requirement per hectare is less. There are several explanations for this. There is a specific track for bullocks and Tropicultor wheels, which tends to increase the speed and thus completes the work faster. On the Flat system the bullock pair hours using traditional implements are higher than using the Tropicultor, though the number of operations are same. This is because of difference in width of coverage for different machines performing similar operations. The traditional blade harrow covers about 60 cm in one pass whereas the Tropicultor cultivator covers 150 cms in one pass. Interrow cultivation with traditional hoe covers about 50-60 cms in one pass whereas the Tropicultor covers 150 cms in one pass and so on.

The cultivation, sowing/planting, and interrow cultivation operations are common for all three systems. The field capacity of cultivation on the flat with the local blade harrow is 10-30% lower than the Tropicultor cultivation with sweeps because of the width of coverage. It should be mentioned that farmers have generally not been very satisfied with the quality of weeding done with sweeps. As a result a blade harrow is now also available for the ADT. The difference in the field capacities of the Tropicultor on flat and B/F systems for cultivation, fertilizer application, planting and interrow operations indicates the effect of having specific track for bullocks and Tropicultor wheels in the B/F system. This also ensures that the full width of the implement is used at all times.

The use of human and bullock labor per hectare in traditional technology varies between locations depending upon the soil type, cropping systems, climatic conditions, etc. (Table 3). The average of three years data (1975-76 to 1977-78) on human and bullock labor use at three locations indicates that farms on Alfisols at Aurupalle require higher bullock and human labor per hectare than farms on Vertisols at Shirapur and Kanzara. The Vertisols at Shirapur and Kanzara also have a different requirement of bullocks and human labor use because of different cropping systems, soil type, and rainfall pattern. At Kanzara crops are grown only in the kharif season and labor requirement is concentrated in that season, whereas at Shirapur crops are grown predominantly in the rabi season.

The human and bullock labor use in the watershed based farming system technology using the Tropicultor on B/F system at Aurupalle in 1979-80 indicates that the use of improved technology has considerably reduced the human and bullock labor for machinery operations. The experience in the villages where we are experimenting with improved technology in Vertisols is that in the first year (1979-80) the total bullock requirement for the improved system was about double that of traditional system (Table 3 and 4). This is mostly because of the development operations. The bullock use of 151 total hours per hectare at Kanzara village in Akola district is inflated by the fact that the traditional implements were used for most of the operations. If we look at the figure for Shirapur village in Sholapur district the total bullock requirement were only 91 hours in the year 1979-80. Even this figure was almost 90% higher than the traditional bullock labor use of 44.5 pair hours/ha. This was because of the improved double cropping or intercropping systems. Similar results shown by Ryan and Sarin (1981).

The overall bullock and human labor requirement for machinery operations at Kanzara and Shirapur village might not be much less with the improved system because the extent to which the development operations of plowing, chiseling, harrowing, ridging and bedforming have to be repeated after number of years.

One of the objectives of on-farm testing of machinery is to assess its performance under normal farm conditions. The results from the Taddanpally village watershed and ICRISAT watersheds (Table 5) indicates that actual field capacities of ridging operation using the Tropicultor at ICRISAT Center and by a farmer at the village is about same. The field capacity of the Tropicultor for cultivation and bed forming operation is higher at Taddanpally than at ICRISAT Center whereas the field capacity for plowing operation is higher at ICRISAT Center than at Taddanpally village. The difference in the field capacities of cultivation, bed forming and plowing may be due to several reasons like the size of the bullocks, soil condition at the time of operation, plot size, number of turnings etc. These results indicate that in general farmer's can achieve the same results when using their bullocks with the Tropicultor as that achieved at a research station. Plowing at Taddanpally was done very late in the dry season when soils were very dry and hard. At ICRISAT plowing on Vertisols is usually started in January after harvesting the rabi crop of chickpea and pigeonpea.

ii) Choutkur village: The actual field capacity of plowing with the Agrikart (single moldboard plow) is almost double that of the desi plow. The draft requirement is approximately the same for both operations. The depth of operations is 14 cms for the moldboard plow and 12 cms for the desi plow. There were 4.5 cm wide unplowed patches left between two passes of the desi plow, the possible reason for lower field capacity may be the lower speed of operation and very slightly higher draft. It is also probable that the stability of an ADT permits an operation to proceed more smoothly and rapidly. This aspect needs to be studied further using both plows on larger areas.

The cultivation operation with three machinery systems i.e. local blade harrow, Agribar and Agrikart indicates that an increase in the soil moisture from 12 to 22% reduced the draft of local blade harrow by 30 kgs. The draft of Agribar was the same at both soil conditions but the draft of Agrikart with one meter blade was reduced by 5 kg. The field capacity of the local blade harrow was approximately doubled at 22% soil moisture whereas the field capacity of Agrikart was the same for both moisture conditions. There was

23 cm overlapping of the local blade harrow at 12% moisture which also contributes to the lower field capacity. The one meter wide blade on the Agrikart needed to be cleaned of weeds every 150 meters whereas the local blade harrow was cleaned at every 50 meters.

The higher field capacities of the Agrikart and Agribar compared to local blade harrow are because the blade in the bukhar is narrower. At 12% soil moisture the draft of Agrikart blade is 25 kg less than the local blade harrow, though the width of the local blade harrow was less and the depth of operation was the same. This aspect needs further study to determine the factors contributing to lower draft with the Agrikart. We probably need to record accurately the forces acting in different components of the implement, tool carrier and load on the neck of bullocks while the machine is in operation.

The draft of the traditional gorru and the Agribar furrow openers was measured. Separate furrow openers used with the Agribar to place both seed and fertilizer keeping horizontal and vertical separation. As a result there were six furrow openers to plant three rows. The average draft of the traditional gorru furrow openers was about 75 kg whereas the average draft of Agrikart furrow openers was about 160 kg. Further development is required to design a furrow opener to place seed and fertilizer with the minimum possible draft.

The fluctuations in the draft of local blade harrow were highest (50-150 kg). The draft fluctuations were negligible with the Agrikart and Agribar. It is not known whether the fluctuations in draft affect the working capacity of bullocks? We need more research to determine how draft variations or fluctuations affect an animals ability to work.

FARMERS REACTION

i) <u>On-farm villages</u>: The farmers at Aurupalle, Kanzara, and Shirapur villages were quite happy with quality of operations with the Tropicultor. A few farmers at Kanzara and Aurupalle have used the Tropicultor on hire basis in 1980-81 season for plowing, cultivation, fertilizer application,

planting, and interculturing operations. This indicates that some farmers at Kanzara, and Aurupalle villages accepted the tool carrier concept. The hire charge has been Rs.15/day for all operations which is a subsidised rate. The actual cost has been calculated to be about Rs. 25.- 35/day (Binswanger, et al 1979).

ii) Choutkur village: The farmers at Choutkur were happy with the coverage and quality of cultivation with the one meter blade behind the Agrikart. Some of the suggestions and reactions from farmers are noted below.

a) There should be provision for cleaning the blade harrow from the lower side in the Agrikart.

b) The angle of blade harrow should be more acute for better penetration.

c) The lifting and lowering handle of machine is hard to operate.

d) Left side of machine operates shallower than the right side.

The farmers comments are related to both design and manufacturing defects in the machine. The manufacturers need to pay attention to improve and maintain the quality of machine.

CONCLUSIONS

1) The Tropicultor (wheeled tool carrier) with a pair of bullock using improved technology can manage to till 2-3 times more land as compared to traditional implements, depending upon the soil type.

2) The Tropicultor has a greater advantage when used on the broadbed and furrow system as compared to the flat system.

3) The use of farmer's bullocks for the Tropicultor in all the villages has not affected the field capacity of the machine compared to results achieved on a research station.

4) At Choutkur village the Agrikart with one meter blade and moldboard plow has shown a definite benefit over the local blade harrow and desi plow in respect to draft requirement and field capacity.

5) The sweeps on the Agribar have not shown any significant improvement over the Agrikart blade harrowing in respect to cleaning, draft requirement, and coverage.

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Table 1: Some characteristics of the ICRISAT on-farm research sites 1978-1981.

Sl. No.	Characteristics	State Dist. Vill.	A.P. Mahbubnagar Aurepally	Maharashtra Akola Kanzara	Maharashtra Akola Kanzara	A.P. Medak Taddanpally	A.P. Medak Choutkur
1	Distance from ICRISAT Centre (km)		100	300	500	42	50
2.	Average annual rainfall (mm)		681	635	815	948	948
3.	Soil type		Shallow alfisols	Deep vertisols	Shallow to medium deep vertisols	Deep, medium vertisols	Medium deep vertisols
4.	Important crops		Sorghum, castor pearl millet, pigeonpea, paddy	Rainy season fallow and post rainy season sorghum, pigeonpea, chickpea minor pulses	Cotton, sorghum, mungbean, G'nut, Pigeonpea	Paddy, Rabi sorghu, C.pea, safflower, G'nut, P.pea, mungbean, ragi, yellow sorgnum	Paddy, Rabi sorghum, C.pea, Safflower, G'nut, P.pea, mungbean, ragi, yeallow sorghum
5.	Households (No)		476	237	169	68	NA
6.	Landless households (%)		28	23	32	>5	NA
7.	Average size of holding (ha)		3.5	6.5	6.1	2.8	NA
8.	Rainfed area to total cropped area (%)		88	92	95	94	NA
9.	Total area of the watershed where improved systems are being tested (ha)		13.5	13	12	15.4	NAP
10.	No. of cooperating farmers holding land on the watershed		5	7	7	15	NAP

Information regarding the villages of Aurepally, Shirapur, Kanzara and Taddanpally is taken from Report of Work: Agronomy and Weed Science, Farming Systems Research Program 1980-81.

Information regarding Choutkur village was provided by Dr. M.K. Sanghi.

N.A. = Not Available

N.A.P. = Not Applicable

Table 2: Performance of Tropicultor (wheeled tool carrier) vs traditional implements on two soil management systems in Alfisols at Aurepally village (1978-79).

Operations		Traditional implements on flat		Tropicultor on flat		Tropicultor on broad beds	
		AFC (ha/hr)	TBH (hrs/ha)	AFC (ha/hr)	TBH (hrs/ha)	AFC (ha/hr)	TBH (hrs/ha)
Chiseling		-	-	-	-	0.20	5.0
Moldboard plowing		-	-	-	-	0.23	4.3
Ridging		-	-	-	-	0.19	5.3
Cultivation	I	-	-	0.14	9.3	0.20	5.0
Cultivation	II	-	-	0.10	10.0	-	-
Blade harrowing	I	0.08	12.5	-	-	-	-
Blade harrowing	II	0.09	11.1	-	-	-	-
Bed shaping		-	-	-	-	0.26	3.8
Fertilizer application		-	-	0.23	4.3	0.36	2.8
Sowing		0.14	7.1	0.28	3.6	0.37	2.7
Seed covering		0.20	5.0	-	-	-	-
Interrow cultivation	I	0.09	11.1	0.19	5.3	0.42	2.9
Interrow cultivation	II	0.14	7.1	0.15	6.6	0.29	3.4
			51.9		38.1		35.2

AFC = Actual Field Capacity

TBH = Total Bullock Pair Hours

Table 3: Use of human[1] and bullock labor in traditional technology for production production of major crops in three SAT villages. (Average of three years 1975-76 to 1977-78).

Village	Operation	Rainy Season		Post-rainy season	
		TBH	THH	TBH	THH
		(hrs/ha)	(hrs/ha)	(hrs/ha)	(hrs/ha)
Aurepally[a] (alfisols)	Field operation and minor repairs	41.9	42.7	66.1	66.1
	Manuring and fertilization	9.9	11.1	19.8	39.5
	Sowing and resowing	32.6	34.1	24.5	29.4
	Interculture	45.2	45.2	19.7	19.7
		126.6	133.1	130.1	154.7
Shirapur[b] (Vertisols)	Field operation and minor repairs	-	-	29.9	31.2
	Manuring and fertilization	-	-	1.2	2.0
	Sowing and resowing	-	-	11.5	11.8
	Interculture	-	-	1.8	6.4
		-	-	44.5	51.4
Kanzara[c] (Vertisols)	Field operation and minor repairs	40.3	59.0	-	-
	Manuring and fertilization	9.4	18.4	-	-
	Sowing and resowing	9.4	16.7	-	-
	Interculture	36.2	48.2	-	-
		95.2	142.3	-	-

TBH = Total Bullock Pair Hours per hectare

THH = Total Male Labor Hours per hectare

[a] Rainy and postrainy season cropping

[b] Rainy season fallow area

[c] Post rainy season fallow area

[1] Human labour use figures are male hours required for machinery operation only

Table 4: Use of human and bullock labor for production of major crops in village watershed experiments (1979-80).

Village	Operation	Rainy season		Post-rainy season	
		TBH (hrs/ha)	THH (hrs/ha)	TBH (hrs/ha)	THH (hrs/ha)
Aurupally	Plowing	16.7	26.6	-	-
	Cultivation	3.8	7.2	-	-
	Ridging	10.7	21.2	-	-
	Harrowing	10.1	15.7	-	-
	Bed formation	6.8	13.1	-	-
	Fertilizer application	4.1	8.2	8.0	9.3
	Sowing	3.0	7.0	5.5	10.9
	Interculture - 1	4.8	6.6	12.7	12.7
	Interculture - 2	4.2	6.1	3.9	4.3
	Interculture - 3	1.8	4.1	3.6	3.6
	Cultivation & ridging	-	-	5.3	6.3
		68.0	115.3	39.0	47.1
Shirapur	Chiseling	15.0	20.6	-	-
	Ploughing	30.9	30.9	-	-
	Harrowing	8.5	8.5	-	-
	Ridging	7.8	18.1	-	-
	Bed forming	6.3	6.6	-	-
	Cultivation & ridging	4.8	9.6	5.5	10.3
	Fertilizer application	1.6	13.9	5.1	12.0
	Sowing	6.9	18.0	4.5	13.1
	Interculture - 1	3.9	7.9	-	-
	Interculture - 2	4.8	8.3	-	-
	Interculture - 3	3.6	7.0	-	-
		99.1	149.4	15.1	35.4
Kanzara	Plowing (local)*	77.7	101.7	-	-
	Harrowing (local)	42.7	42.7	-	-
	Bed formation	9.0	9.0	-	-
	Sowing & fertilization	7.5	15.7	-	-
	Interculture - 1	2.4	9.0	-	-
	Interculture - 2	4.8	9.5	-	-
	Interculture - 3	1.1	2.1	-	-
	Ridging	5.0	9.3	-	-
		151.2*	209.0*	-	-

* All development operations prior to Bed formation in Kanzara village were carried out with local implements. This explains the much higher figures.

TBH - Total bullock pair hours
THH - Total male labor hours

Human labor use figures are male hours required for machinery operations only

Table 5: Performance of Tropicultor on B/F for different operations in Taddanapally village vs ICRISAT Center.

Operation	Taddannapally village** (1980-81)		ICRISAT Center*	
	AFC (ha/hr)	TBH (hr/ha)	AFC (ha/hr)	TBH (hr/ha)
Moldboard plowing	0.11	9.09	0.17	5.88
Ridging	0.24	4.34	0.24	4.16
Cultivation with sweeps	0.10	9.09	0.21	4.76
Bed shaping	0.29	3.44	0.23	4.34
Total		20.20		19.14

* Average of 7 watersheds at ICRISAT Center having 64 ha.

** The 15.42 ha watershed belongs to 14 farmers.

AFC Actual field capacity.

TBH Total bullock pair hours.

Table 6: Comparative data on desi plow and Agrikart with single moldboard plow at Choutkoor village in Vertisols.

Date of Operation: 29-8-1981 Soil moisture : 11.5%

	Agrikart	Desi plow
Average draft (kg)	160	170
Depth of operation (cms)	14	12
Theoretical width (cms)	22	25
Actual width (cms)	20	29
Actual field capacity (ha/hr)	0.13	0.07
Time per hectare (hr/ha)	7.69	14.28

Table 7: Comparative data for local and improved implements for cultivation operations in Vertisols at Choutkoor village.

Date: 22-8-1981	Soil moisture: 12.5%		
	Agrikart (1 meter blade)	Low cost tool bar	Local blade harrow
Average draft (kg)	100	120	125
Depth of operation (cms)	6	7	6
Theoritical width (cms)	100	120	58
Actual width (cms)	97	120	45
Actual field capacity (ha/hr)	0.12	0.18	0.04
Time per hectare (ha/hr)	8.33	5.55	23.80
Cleaning efficiency	Once in 150 meters	-	Once in 50 meters

Date: 10-10-1981	Soil moisture: 23.0%		
Average draft (kg)	95	120	95
Depth of operation (cms)	6	7	6
Theoritical width (cms)	100	120	58
Actual width (cms)	96	120	56
Actual field capacity (ha/hr)	0.12	0.15	0.075
Time per hectare (ha/hr)	8.33	6.65	13.33