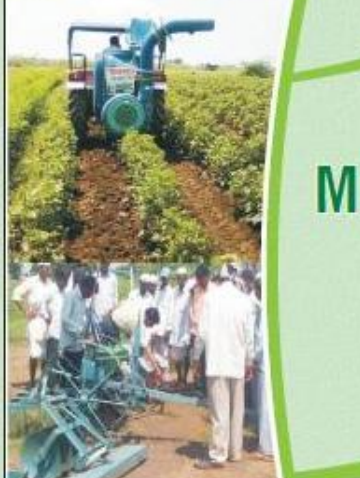




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FARM MECHANIZATION IN COTTON



Zonal Project Directorate, Zone-1
Indian Council of Agricultural Research
PAU Campus, Ludhiana-141004

Cotton Shredder

- ◀ It should be operated at proper moisture condition.

Angle of insertion of blade is very important while uprooting.

- ◀ Reduce the drudgery in cotton cultivation.
- ◀ Crop residue incorporation is additional source of organic matter which improves and maintain the soil health.

Self Propelled Rotolasher

- ◀ For good slashing, moisture content in crop residue should be less & field should be stoneless.

- ◀ Skilled and healthy labour only can operate the machine.

- ◀ Requires petrol engine or easily started engine instead of rope started diesel engine.

Conclusions

The mechanization in cotton crop is the need of the hour, considering its importance in the growth of National Economy and Indian farmers. Mechanization in cotton with farm implements will not only solve our labour crunch problem, but will also help in reducing human drudgery. It will lead to increase in sustainable cropping intensity as well as productivity to achieve a desirable growth rate in cotton production. The improved farm implements have performed better in terms of capacity/output, Man-hr/ha and cost of operation. The state Governments are also providing subsidies on costly implements for their popularization among farming community. These improved farm implements are also being used by resource poor farmers on custom-hiring basis. The pooled information on farm implements related to cotton crop will be useful to policy planners, researchers and extension personnel.

Farm Mechanization in Cotton

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Battery Operated
knapsack Sprayer

- ◀ Uniform coverage with minute droplets.
- ◀ Reduces time and drudgery and saves fuel.
- ◀ Use of Battery operated knapsack sprayer for spraying in comparison with non battery operated knapsack sprayer save approximately 40 to 45% time, labor and money.

Rechargeable Sprayer

- ◀ It is drudgery reducing sprayer as labour being used for pumping paddle in traditional sprayer is not required.
- ◀ Very fine droplets are given by the sprayer.
- ◀ One can not depend on the farm labour, farmer/farm owner himself can go for spraying in his field.

Motorized Knapsack
Sprayer

- ◀ Time saving, spraying done at constant speed to cover the entire crop and reduced hard work during spraying.
- ◀ Generate employment among the youths in villages.

Mist Blower

- ◀ Equipment cost is high.
- ◀ Smooth running with light weight.
- ◀ High coverage due to pressure system.
- ◀ Uniform coverage with minute droplets.

F Post Harvest Equipments

Stalk Uprooter

- ◀ It is easy to uproot cotton stalk from irrigated fields as compared to rainfed fields.
- ◀ Tractor operator should be skillful.
- ◀ It takes less time when the field length is more as the tractor has to take less turns.

- ☛ Considering the wind direction, Aeroblast sprayer is best suited where the crop rows are perpendicular to the direction of wind.
- ☛ In rainy season, it cannot be operated due to wet soil conditions.
- ☛ The propeller shaft should be attachable to all tractors.
- Bullock Drawn Ridger**

 - ☛ While operating, the soil is displaced outward. It is efficient than traditional method.
 - ☛ Handling and operations are easier.
 - ☛ Used for various spacing in cotton.
- Boom Sprayer**

 - ☛ It is a time and cost saving sprayer.
 - ☛ Covers large area in short time.
 - ☛ Uniform and effective spraying pattern is achieved.
- Brahma Bullock drawn sprayer**

 - ☛ Performance was good in the early stage of crop.
 - ☛ Saved Labour, Time & Cost.
 - ☛ At the time of turning, destruction of other field crops observed. Sufficient fallow land of 3mtr. width is required at the end of field otherwise crop damage occurs at the turning.
 - ☛ Break up of some branches of plant was observed in 2.5x2.5 ft spacing fields at boll formation stage.
 - ☛ The work of changing the spacing between the wheels of sprayer have to be done from field to field.
- Taiwan Sprayer**

 - ☛ Equipment cost is high.
 - ☛ Smooth running with light weight.
 - ☛ High coverage due to pressure system.

डॉ. कि. र. कोकाटे
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Forward

India has the largest area under cotton cultivation amongst all the countries of the world. However, the productivity of cotton is much lower than the productivity levels attained by major cotton growing countries of the world. This crop generates employment opportunities to millions of people not only at the production stage, but also in processing, marketing and trade. Considering the importance of cotton crop in the National economy, Government of India had launched Technology Mission on Cotton (TMC) in February 2000 with the objectives of improving production, productivity and quality of cotton so as to enable Indian cotton to compete globally in the free market economy under WTO regime. Four Mini Missions have been established to fulfil the aforesaid objectives. Mini Mission I is with Indian Council of Agricultural Research to look after the component of research; Mini Mission II with Ministry of Agriculture, Department of Agricultural Cooperation for transfer of Technology; and Mini Mission III and IV with Ministry of Textile to develop market infrastructure and modernizing Ginning and Pressing factories respectively.

Financial assistance through Mini Mission II of TMC has been provided for the purchase of farm implements as well as for conducting of Front Line Demonstrations. Improved farm implements and machinery play a very important role in enhancing the production and productivity of cotton. It is possible to maintain with mechanisation multiple cropping patterns, which need quick land preparation, planting, weeding, harvesting and processing etc. The KVKs in the cotton growing tract of the country conducted Front Line Demonstration on various farm implements viz. seed processing, sowing, tillage, weeding and spraying.

I am happy that Zonal Project Directorate, Zone-I has pooled the information related to cotton mechanisation. I appreciate the efforts of authors for bringing out this valuable publication on Farm Mechanisation in Cotton which is need of the hour. Farm mechanisation with implements will not only overcome our labour problem, but also help reducing human drudgery.


(K.D. Kokate)

- ◀ Reduction of the length of weeder is suggested because it is difficult to turn weeder.
 - ◀ At the time of turning of weeder, there is no provision for reducing speed of engine and constant speed creates problem while turning. Sometimes, weeder moves out of control and damages the plants.
 - ◀ The implement is suitable for weeding operation but clogging of iron wheels occurs in sandy and high moisture soil. So iron wheel should be replaced by pneumatic wheel to make it work properly.
- Engine stop switch required at the hand of operator.

E Spraying Equipments

Power Sprayer

- ◀ Reduction of drudgery in spraying.
- ◀ Women labourers can operate the sprayer because of the less weight compared to traditional equipments.
- ◀ Reduction in cost of cultivation because of the electrical recharge which eliminates the cost incurred for the diesel, oil etc.

Aeroblast Sprayer

- ◀ Aero blast sprayer covers large area very quickly and effectively but its initial cost is not affordable to small farmers.
- ◀ Most suitable for all types of crop.
- ◀ Easy to operate but support wheel required below pump. Spacing between rows is required for movement of equipment.
- ◀ Time and labour saving device.
- ◀ Requires high power tractor.
- ◀ Use of aeroblast sprayer after flowering becomes limited.

- ❖ Blades break frequently.
- ❖ Can not be used in rainy season and in more clayey soil.
- ❖ Battery operated weeder may be developed to reduce the fuel cost.
- ❖ It needs more head land for turning.
- ❖ If the field is surrounded by other crops with ridges and bunds it is difficult to carry to the other fields.
- ❖ Good to use during initial stages. When operated in the later stage, flowers, bolls and branches damage occurs.
- ❖ As it stirs the soil well, the rainwater percolates and runoff is reduced. This reduces water requirement of crop.
- ❖ Crop growth was improved by increased aeration at the root surface.
- ❖ Marginal farmers are interested to own this power weeder due to huge savings in time, labour and cost.
- ❖ Cost of power weeder is not affordable for small farmers if used only for weeding operation. Farmers preferred power tiller attached implements to reduce prime mover cost for every operation and not in an integrated unit.
- ❖ Besides weeding, the power weeder can also be used for earthing up operation which checks stem weevil problem.
- ❖ During off-season, it can be used for orchards, vegetable crops and plantation crops like amla, sapota, mango, coconut etc.
- ❖ Easy to operate, but operator needs rest in between to avoid exhaustion.

Acknowledgment

We take this opportunity to thank Dr. K.D. Kokate, Deputy Director General (Agril. Ext.) for his motivation and guidance to document this bulletin.

Our thanks are due to Ministry of Agriculture, Department of Agriculture & Cooperation, Govt. of India for providing financial support under Technology Mission on Cotton. We are also grateful to Dr. Anupam Barik, Director, DOCD, Mumbai for encouraging us and sharing valuable information on farm implements in cotton.

We are also grateful to programme Co-ordinators and subject matter specialists of the KVKs who participated in the programme of Front Line Demonstration on Farm Implements in Cotton and also sharing their technical reports with us.

Authors

D Weeding Implements

Manual Weeders (Single and peg type):

- Performance is satisfactory in black cotton soil.
- Useful only for first two weedings.
- More time requirement than the traditional practice.
- Operation preferred in closed spacing crop.
- Peg type weeders help in mixing the cut weeds in to soil for mulching.

Power Weeder

- Field capacity depends on soil moisture condition and skill of labour.
- Minimum 2.5x2.5 ft. spacing of crop required.
- Helps in mixing the cut weeds into soil.
- Effectively controls the late emerging weeds.
- Optimum soil moisture is required for the effective operation.
- Reduces the weeding, bunding and earthing up cost and also saves time considerably.
- It is very much convenient for the farmer to operate because of less horse power.
- Weeds are removed and dried in the field itself and enriches the soil fertility status.
- Seeds of the weeds are crushed and damaged by the machine while operation, and do not germinate. Hence, number of weeding operations are reduced.
- While weeding, depth of tynes to be operated can be adjusted based on the soil type and soil moisture availability.

Sub Soiler

- Ploughs up to 45 cm -60 cm depth for easy establishment of roots.
- Removal of deep-rooted weeds is easily achieved.
- Control of soil born pathogens and pupae of pests
- Increases water-holding capacity of soil to support plant growth.
- Removes hard pans and avoid sub soil compaction.

Rotary Tiller

- Implement cost is very high.
- Cutting and incorporation of stubbles and weeds are effective.
- Pulverization of soil is good.
- Gives fine tilth.
- Single operation is sufficient for sowing.
- Depth coverage is not enough in heavy soils.
- Optimum moisture is necessary to get good tilth.

Bullock Drawn Ridger

- While operating, the soil is displaced outwards. It is efficient than traditional method.
- Handling and the operations are easier.
- Used for various spacing in cotton.

Tractor Drawn Disc Harrow

- Incorporation of the cotton stalk material into the soil helps in increasing organic matter of soil.
- The lower part of the stalk does not get incorporated & should be collected manually.
- Operator should be skillful.
- Cross harrowing is necessary to achieve required incorporation.

Preface

In India, Cotton is grown under diverse agro-climate conditions in about 10 million hectares and ranks first in the world. The productivity level of the crop has improved after the introduction of Bt. hybrids and it is more than 500 kg lint/ha. It is still less than the world's average. Its vital role in the national economy and its contribution in foreign exchange earning is tremendous. In view of low yield and poor lint quality and considering the importance of cotton crop in the National economy, Government of India has launched Technology Mission on Cotton (TMC) in February, 2000 with the objectives of improving production, productivity and quality of cotton so as to enable Indian cotton to compete globally.

Improved farm implements and machinery play a very important role in enhancing the production and productivity of cotton. Mechanization actually leads to timely operations, precise farming, higher production thereby creating demand for more labour engagement and drudgery reduction. Out of four Mini Missions initiated, Mini Mission-II of TMC has the responsibility of transfer technology from Research Institutions to farmer's fields so as to increase the yield per hectare and reduce cost of cultivation. Front Line Demonstrations on farm implements were conducted during 2005-08 in 10610.45 ha area benefitting 12085 farmers. Farm Implements were demonstrated in 46 districts of 10 states with the financial support from Mini Mission II of technology Mission on cotton. This bulletin provides detailed information on usefulness of seed treatment equipments, sowing implements, tillage implements, weeding implements, spraying equipments and seed processing implements involved in production of cotton crops for achieving maximum productivity and farm mechanization in cotton crop to reduce the human drudgery. The feedback on these implements/ equipments from scientists, farmers and extension personnel has also been provided in this bulletin.

Authors

- ◀ Water holding capacity improves by incorporation of previous crop residues.
- ◀ Reduction in labour cost for ploughing operation is observed.
- ◀ Weed suppression observed for a period of one month.
- ◀ Using rotavator followed by 5 tyne chisel plough pulverized the soil into fine tilth.
- ◀ The farmers use spring tyne cultivator 4 times for getting fine tilth. Instead of this one time use of cultivator followed by rotavator saves time, energy and cost.
- ◀ It was observed that the fine tilth was obtained by rotavator only after ploughing by primary tillage implements.
- ◀ To get a fine tilth by rotavator, soil moisture should be optimum.
- ◀ The length of the connecting rod is predetermined. Hence the rotavator could not be connected with all models of tractors. Especially the rotavator connector to PTO shaft of Mahendra models requires remodification.
- ◀ Reduced the drudgery for labourers engaged in the cleaning of previous crop residues.
- ◀ Chopping and incorporation of previous crop residues to the soil itself improves the physical, chemical and biological characteristics of the soil besides building up the soil organic matter content.
- ◀ It is very useful to cultivate grassy land before cotton sowing.
- ◀ It acts as a good clod crusher, make easier to plant cotton seeds in soil.
- ◀ Initial cost of implement is higher.

Tractor Drawn Disc Plough

- Beside timely operation, it saves cost and labour.
- It could be used for preparation of wide space ridges and furrows as well as use for clod crushing.
- As it ploughs up to 30cm-45 cm depth, better pulverization of soil takes place.
- Effective removal of deep-rooted weeds which influence good crop yield.
- Improves soil mulching and prevents evaporation loss of water from soil.
- Soil born pathogens and pupae of pests are controlled effectively.
- Increased the root penetration of cultivable crops.
- Increased water holding capacity resulting high moisture content of soil.
- Removed hard pans and avoid sub soil compaction.

Tractor Drawn Rotavator

- Incorporates cotton biomass into soil which improves soil properties.
- Repeated use of rotavator makes the subsoil layer hard so it is necessary to plough the land periodically once in year under irrigated condition where two or three crops are cultivated throughout the year, while plough the land once in three years under rainfed condition where only one crop is cultivated in a year.
- Performs primary and secondary tillage operation in one single operation to get deep well pulverized seedbed for good nourishment and anchorage of plants.

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Pneumatic Cotton Planter

- Seed requirement can be reduced up to 40%.
- Inter-cropping can be adopted easily and 2 or 3 crops can be sown at a time.
- Operating speed is very slow.
- Precision and accuracy of planting is good but line marker is necessary for row setting.
- Suitable for dry sowing or sowing at vapsa field condition.
- Faulty design of shaft leads to breaking of shafts frequently.

Bullock Drawn Cotton Planter

- There should be row marker to maintain the row to row spacing.
- The planter is driven at constant speed without jerks.
- Some space should remain unplanted for the process of turning at the end.
- Planter should be designed for irrigated cotton cultivation i.e. furrow irrigation.
- Frequent seed tube blockage.

Naveen Dibbler

- Clogging of dibbler takes place under heavy moist soil.
- Land must be well prepared for operation.
- Single seed can not be dibbled.
- Last preference for gap filling due to damage of seed.

**C Tillage Implements
Mould Board Plough**

- It avoids gully formation and levels the field at the time of ploughing hence widely accepted by farmers.
- Saving of time and diesel than traditional plough.

Feed back on Farm Implements

During conductance of Front Line Demonstrations of these farm implements at farmer's fields, the feed back received from scientist/farmer/extension personnel is given below:

Sr. No.	Name of the Equipment/ Implement	Feedback
A Seed Processing implements		
	Liliput Gin	<ul style="list-style-type: none"> ☛ Fiber separated seeds are of good quality and the operation is speedy. ☛ As machine is small in size and handy, it can be easily transported with the help of handles fixed on to both the sides. ☛ Can operate continuously for 8-10 hrs. ☛ Ginning efficiency is quite good with less seed damage. ☛ Pure seed of cotton and good quality lint can be obtained as compared to commercial ginning machine.
	Cotton Seed Delinter (manual)	<ul style="list-style-type: none"> ☛ More precautions has to be taken for operation. ☛ Increase in amount of conc. sulphuric acid or time of mixing, tends to bum the seed. ☛ Saved labour & time but not cost as compared to traditional practice. ☛ Good germination of seeds.
B Sowing Implements		
	Seed cum Fertilizer Drill	<ul style="list-style-type: none"> ☛ It is useful to maintain plant spacing. ☛ It is a seed, time and labour saving device.

Farm Mechanization in Cotton

Introduction

Cotton often referred as "white gold" has been in cultivation in India for more than five thousand years. The area in India is more than 10 million hectares (the largest in the world) and provides livelihood for over 4 million farming families. As regards to productivity of cotton, India is far behind from other cotton producing countries. Productivity of cotton in India is as low as 503 kg lint/ha, a small country like Turkey produces 1291 kg lint/ha and occupies the 1st rank in the world. The productivity of cotton in China and USA was 1130 and 858 kg lint/ha respectively in 2006-07. The higher productivity in these countries is mainly due to innovative and modernized methods of cultivation. There is a tremendous scope yet to increase the production in India. Mechanization is one of the modern need base component for producing more and more at low cost of production.

Improved farm implements and machinery play a very important role in enhancing the production and productivity of cotton. There is a burning problem of unavailability of farm labourers during peak period of different farm operations; there is need of extra labour to an extent of 40% of the existing labour population. Some of the labours are migrated temporarily from the nearby villages during peak period of different farm operations. Demand of higher wages are observed & quality of work is also seen low during this period. This results in high cost of operation and more time affecting the yield and net income. Mechanization is an important tool for sustainable, profitable and competitive agriculture. Without mechanization, it will not be possible to maintain multiple cropping patterns, which need quick land preparation, planting, weeding, harvesting, processing etc.

Mechanical interventions can be made through mechanization of tillage, planting, inter-cultural & plant protection operations for efficient utilization of costly inputs. Precision farming allows farmers to take economic decisions about input use while avoiding environmental degradation. This is essential to sustain profitable productivity levels of cotton based cropping systems.

Demonstration on Farm Implements

Demonstrations on farm implements were conducted from 2005-08 in 10610.45 ha area in which 12085 farmers participated. The details are as follows.

Farm Implements	Area (ha)	No. of Farmers
Ginning and Delinting	682.15	749
Dibbler, Seed treatment Drum, Planter and Seed Drills	1127.4	1150
Tillage (Rotavator, Furrow Maker, Harrow, Plough, Tiller) and Stalk Uprooter/ Rotoslasher and Stalk Shredder	3527.6	4472
Weeders	1651.9	2242
Sprayers	3621.4	3472
Total	10610.45	12085

State-wise details of Demonstrations on Farm Implements

Farm implements were demonstrated in 46 districts of 10 states. The state-wise detail of demonstrations on farm implement is given below.

State	District	Area (ha)	No. of farmers
Andhra Pradesh	Guntur	894	685
	Karimnagar	1021	1316
	Krishna	251	108
	Kumool	221.8	171
Gujarat	Sabarkantha	182	196
	Banaskantha	67.75	91
	Bharuch	210	97
Haryana	Bhiwani	78	50
	Sirsa	123	197
	Jind	98	162
	Rohtak	34	72
Karnataka	Belgaum	258.34	223
	Belary	28	48
	Chitradurga	28	92

Efficiency Indicators	Traditional	Improved	Centres
	Tractor V Pass	Self propelled rotoslasher	
Capacity/out put (ha/hr)	0.37	0.20	Amravathi (G), Yavatmal Jalna, Nagpur (Maharashtra)
Man-hr/ha	83	5	
Cost of operation (Rs./ha)	1275	385	

Traditional Practice



Disposal of cotton stalk residues by Tractor V-Pass

Improved Practice



Disposal of cotton stalk residues by Self Propelled Rotoslasher

Efficiency Indicators	Traditional	Improved	Centres
	Traditional cultivator	Stalk uprooter	
Capacity/out put (ha/hr)	0.04	0.25	Faridkot, Bathinda (Punjab), Nandurbar (Maharashtra), Karimnagar (A.P.)
Man-hr/ha	33	9.58	
Cost of operation (Rs./ha)	625	422	

Traditional Practice



Manual Cotton Stalk Uprooter

Improved Practice



Tractor Drawn Cotton Stalk Uprooter

Cotton Shredder

The demonstration of shredder was conducted in Salem district and the efficiency of cotton shredder was found superior over manual pulling.

Efficiency Indicators	Traditional	Improved	Centres
	Manual Pulling	Cotton Shredder	
Capacity/out put (ha/hr)	0.02	0.22	Salem (Tamilnadu)
Man-hr/ha	30	4.5	
Cost of operation (Rs./ha)	1800	1185	

Self Propelled Rotolasher

The efficiency indicators showed that self propelled Rotolasher was found superior to traditional method. In the traditional method by tractor V-Pass, the cotton sticks are disposed of and have to be collected manually.

State	District	Area (ha)	No. of farmers	
Madhya Pradesh	Koppal	58	92	
	Raichur	23.34	47	
	Gadag	142	176	
	Cihindwara	65.8	142	
	Maharashtra	Ahmednagar	718	834
		Akola	787	840
		Amaravathi	721.7	598
		Beed	24.8	168
Buldhana		396	393	
Dhule		140	350	
Jalna		471	413	
Nandurbar		510	383	
Punjab	Washim	431.82	438	
	Yavatmal	28	325	
	Ferozpur	163	125	
	Muktsar	188.5	272	
	Faridkot	263	142	
	Bathinda	374	291	
	Rajasthan	Sri Ganganagar	110	95
		Hanumangarh	185	175
Tamilnadu	Coimbatore	34	74	
	Cuddalore	114	124	
	Erode	89	124	
	Krishnagiri	79.6	181	
	Madurai	99	174	
	Perambalur	214	244	
	Salem	214	224	
	Tirunelveli	74	87	
Vellore	74	149		

State	District	Area (ha)	No. of farmers
	Vilupuram	49	94
	Virudhunagar	64	74
West Bengal	South 24-Parganas	210	336
Total		10610.45	12085

Seed Processing Equipments

Liliput Gin

The performance of seed processing implements revealed that cloy gin (Liliput Gin) was superior to hand operated machine in six centres viz. Amravathi (D), Dhule, Kumool, Buldhana, Banaskantha and Gadag.

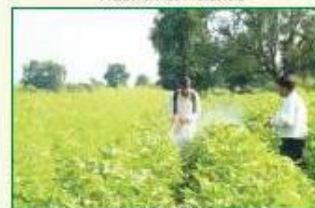


Demonstration of Liliput Gin

Operation	Efficiency Indicators	Traditional*	Improved	Centre
		Hand operated Machine	Liliput Gin	
Ginning	Capacity/ out put (kg/hr)	-	3.2 kg lint	Gadag (Karnataka)
	Man-hr/kg	-	Low	
	Cost of operation (Rs./qt)	-	0.31	
* as traditional method, only commercial ginning				
Ginning	Capacity/output (Kg/ hr)	8.75	9	Banaskantha (Gujarat)
	Man-hr/ha	0.14	0.14	
	Cost of operation (Rs./qt)	185	132	
Ginning	Capacity/output (Kg/ hr)	0.1	5.5	Amravathi (D) (Maharashtra)
	Man-hr/ha	10	0.18	
	Cost of operation (Rs./qt)	60	684	

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Traditional Practice



Power Sprayer

Improved Practice



Rechargeable Sprayer

HTP Sprayer (Taiwan Sprayer)

The capacity of HTP sprayer was far superior as compared to traditional power sprayer and cost of operation and man-hr/ha were reduced to half.

Efficiency Indicators	Traditional	Improved	Centers
	Power sprayer	Taiwan sprayer	
Capacity/ out put (ha/hr)	0.05	1	Jalna, Beed, (Maharashtra), Krishna, Guntur, Karimnagar, Kumool (Andhra Pradesh)
Man-hr/ha	6	3	
Cost of operation (Rs/ha)	200	100	

Traditional Practice



Power Sprayer

Improved Practice



Taiwan Sprayer

Post Harvest Equipments

Stalk Uprooter

Cotton stock-uprooter demonstration was conducted in four districts. Efficiency was superior and man-hour requirement was much less than traditional cultivators. The cost of operation was also less in improved equipment.

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Traditional Practice



Knapsack Sprayer

Improved Practice



Brahma Bullock Drawn Sprayer

Mist blower was demonstrated in Kareem Nagar and Ahmednagar centres and it was observed that the mist blower was superior in cotton spray operations.

Efficiency Indicators	Traditional	Improved	Centers
	Power sprayer	Mist blower	
Capacity/output (ha/hr)	0.05	0.18	Karimnagar (Andhra Pradesh), Ahmednagar (Maharashtra)
Man-hr/ha	20	5.5	
Cost of operation (Rs/ha)	175	102.3	

Rechargeable Sprayer

Rechargeable sprayer was compared with power sprayer. It was some what superior in terms of capacity and man-hour requirement compared to the power sprayer.

Efficiency Indicators	Traditional	Improved	Centers
	Power sprayer	Rechargeable	
Capacity/output (ha/hr)	0.053	0.084	Buldhana (Maharashtra)
Man-hr/ha	5.0	4.0	
Cost of operation (Rs/ha)	125	125	

Delinting Equipment

In delinting process, the capacity (kg/hr) of power operated machine was superior over the traditional method. But the cost of operation for power operated machine was little bit higher than the traditional method. Cotton Seed delinting machine (power operated) reduced the drudgery and helps to speed-up the delinting process.

Traditional Practice



Rubbing Soil by hand

Improved Practice



Cotton Seed Delinting (Manually operated)

Operation	Efficiency Indicators	Traditional	Improved	Centre
		Rubbing Soil by hand	Machine (power operated)	
Delinting	Capacity / output (Kg/ hr)	17	20	Amravathi (D) (Maharashtra) Gadag (Karnataka)
	Man-hr/ha	0.063	0.067	
	Cost of operation (Rs/ha)	57	925	
Delinting		Rubbing Soil by hand	Cotton Seed delinting machine (Manual operated)	
	Capacity / output (Kg/ hr)	25	32	Amravathi (G) (Maharashtra)
	Man-hr/ha	0.04	0.03	
	Cost of operation (Rs/ha)	35	652.32	

Seed Treatment Implement :

Seed Treating Drum (Manually Operated)

Seed treatment with seed treating drum performed better in respect of all efficiency indicators.

Operation	Efficiency Indicators	Traditional	Improved	Centre
		Rubbing by hand	Seed treating drum	
Seed treatment	Capacity / output (Kg / hr)	30	44	Amaravathi (G) (Maharashtra)
	Man-hr/ha	0.033	0.022	
	Cost of operation (Rs./qt.)	29	20	

Traditional Practice



Rubbing by hand

Improved Practice



Seed Treating Drum (Manually operated)

Sowing implements

Seed cum Fertilizer Drill

Sowing with drill was very much superior over hand seeding with considerably less cost of operation (Rs. 820 with hand seeding and Rs. 374.75 with drill seeding) and 4.6 time reduction in man hours/ha.

Efficiency Indicators	Traditional	Improved	Centers
	Manual Planting/ Seeding	Seed cum Fertilizer Drill	
Capacity/out put (ha/hr)	0.18	0.55	Hanumangarh (Rajasthan), Jind, Sirsa (Haryana) Faridkot (Punjab)
Man-hr /ha	17.19	3.69	
Cost of operation (Rs./ha)	820	374.75	



Boom Sprayer

Battery Operated Knapsack Sprayer

Efficiency Indicators	Traditional	Improved	Centers
	Power sprayer	Battery operated knapsack sprayer	
Capacity/out put (ha/hr)	0.4	1.3	Washim (Maharashtra)
Man-hr /ha	3.2	2.0	
Cost of operation (Rs./ha)	80	50	

Brahma Bullock Drawn Sprayer

This equipment was superior in terms of all efficiency indicators compared to the knapsack and power sprayer in terms of capacity, man-hrs. and cost of operation.

Efficiency Indicators	Traditional	Improved	Centers
	Knapsack sprayer	Brahma Bullock drawn sprayer	
Capacity/out put (ha/hr)	0.15	1	Amaravathi (G) Jalna (Maharashtra)
Man-hr /ha	13.34	2	
Cost of operation (Rs./ha)	134	37.50	

Aeroblast Sprayer

Aeroblast sprayer was demonstrated in Rajasthan, Gujarat, Punjab, Haryana and Maharashtra. The sprayer performed much better than the Knapsack sprayer in terms of capacity and man-hour requirement. The capacity is 7 times more and man-hours required are 7 times lesser.

Efficiency Indicators	Traditional		Centers
	Knapsack Sprayer	Aeroblast sprayer	
Capacity/out put (ha/hr)	0.133	0.96	Sriganganagar, Hanumangarh (Rajasthan), Bharuch (Gujarat), Ferozepur, Muktsar, Faridkot, Bathinda (Punjab), Sirsa (Haryana), Amravathi, Ahmednagar, Nandurbar (Maharashtra)
Man-hr/ha	7.5	1.04	
Cost of operation (Rs/ha)	87.5	483	

Traditional Practice



Knapsack Sprayer

Improved Practice



Aeroblast Sprayer

Boom Sprayer

Boom sprayer was compared with Knapsack sprayer and it was observed that Boom sprayer was superior over the traditional one specially in terms of capacity and man-hrs.

Efficiency Indicators	Traditional		Centers
	Knapsack Sprayer	Boom sprayer	
Capacity/out put (ha/hr)	0.09	2.5	Sabarkantha and Banaskantha (Gujarat)
Man-hr/ha	16	2	
Cost of operation (Rs/ha)	100	84	



Manual Sowing



Sowing with Seed cum Fertilizer Drill

Pneumatic Cotton Planter

The sowing with pneumatic cotton planter was compared with hand sowing. The requirement of man-hr/ha was 80 with hand sowing where as it was 1.19 in Pneumatic planter. The cost of operation was also reduced to half.

Efficiency Parameters	Traditional		Centers
	Hand sowing	Pneumatic Cotton Planter	
Capacity/out put (ha/hr)	0.04	0.45	Hanumangarh (Rajasthan) Bhiwani, Sirsa, Jind, Rohtak(Haryana) Washim Jalna, (Maharashtra), Bharuch (Gujrat)
Man-hr/ha	80	1.19	
Cost of operation (Rs/ha)	465	280	



Sowing with Pneumatic Planter

Bullock Drawn Cotton Planter

Bullock drawn cotton planter reduced drudgery, saved time and dependency on labours and ensured timely operations.

Efficiency Parameters	Traditional	Improved	Centers
	Dibbling	Bullock drawn cotton planter	
Capacity/out put (ha/hr)	1.45	2.57	Nandurbar, Jalna (Maharashtra)
Man-hr/ha	7.50	5.54	
Cost of operation (Rs./ha)	126.35	244.50	



Bullock Drawn Cotton Planter

Naveen Dibbler

Naveen dibbler was suitable for gap filling and its efficiency was more when compared to manual gap filling.

Efficiency Parameters	Traditional	Improved	Centers
	Manual gap filling	Naveen dibbler	
Capacity/out put (ha/hr)	0.0625	0.075	Akola & Amravathi (Maharashtra)
Man-hr/ha	16	13.33	
Cost of operation (Rs./ha)	100	84	

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Efficiency Indicator	Traditional	Improved	Centres
	Knapsack Sprayer	Power Sprayer	
Capacity /out put (ha/hr)	0.068	0.617	Belgaum, Chitradurga (Karnataka), Chhindwara (Madhya Pradesh)
Man-hr/ha	65	17.1	
Cost of operation (Rs./ha)	850	350	

Traditional Practice



Knapsack Sprayer

Improved Practice



Petrol driven Power Sprayer

Battery Driven Power Sprayer

The demonstrations were conducted in Tamilnadu, Maharashtra, Gujarat and Andhra Pradesh. Battery drawn power sprayer proved its efficiency against knapsack sprayer in terms of capacity and man-hrs.

Efficiency Indicators	Traditional	Improved	Centers
	Knapsack Sprayer	Power Sprayer	
Capacity/output (ha/hr)	0.063	0.4	Salem (Tamilnadu), Ahmednagar, Jalana, (Maharashtra), Bharuch (Gujarat), Karimnagar (Andhra Pradesh)
Man-hr/ha	24	3	
Cost of operation (Rs./ha)	830	260	
Level of drudgery	1	3	
Application rate (l/ha)	500	200	

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Efficiency Indicators	Traditional Bullock driven harrow followed by hand weeding by Khurpi	Improved Single wheel hoe weeder	Centres
Field Capacity/output (ha/hr)	0.1	0.01	Amravathi (D), Amravathi (G), Ahmadnagar (Maharashtra), Bharuch (Gujarat)
Cost of operation (Rs./ha)	1775	1325	
Man-hr/ha	260	128	
Total weed biomass (kg/m ²) (Before)	0.8	0.8	
Total weed biomass (kg/m ²) (After)	0.035	0.034	



Demonstration of Single Wheel Hoe Weeder

Spraying Implements

Petrol Driven Power Sprayer

Power Sprayer and Knapsack Sprayer were compared. The efficiency indicators were superior in power sprayer compared to the traditional sprayer specially in terms of man-hrs. and capacity.

Traditional Practice



Manual Gap filling

Improved Practice



Gap Filling by Haveen Dibble

Tillage Implements

Rotavator

Rotavator was compared with traditional cultivators and the tractor operated rotavator was found much superior in man-hour requirement at all the locations. The details of the observations are given below.

Efficiency Indicators	Traditional	Improved	Centers
	Spring Tyne Cultivators	Rotavator	
Capacity/output (ha/hr)	0.213	0.335	Cuddalore, Erode, Krishnagiri (Tamilnadu), Guntur (Andhra Pradesh)
Man-hr/ha	5	3	
Cost of operation (Rs./ha)	1,925	1,500	
	Country Plough	Rotavator	
Capacity/output (ha/hr)	0.05	0.4	Salem (Tamilnadu)
Man-hr/ha	20	3	
Cost of operation (Rs./ha)	675	1500	
	Manual uprooting	Rotavator	
Capacity/output (ha/hr)	0.02	0.2	Sabarkanta (Gujarat)
Man-hr/ha	40	3.0	
Cost of operation (Rs./ha)	2,500	1500	

Efficiency Indicators	Traditional	Improved	Centers
	Manual uprooting	Rotavator	
Capacity/output (ha/hr)	0.65	1.2	Bathinda (Punjab), Jind, Sirsa (Haryana)
Man-hr/ha	1.75	0.75	
Cost of operation (Rs./ha)	900	700	
	Disc Harrow	Rotavator	
Capacity/output (ha/hr)	0.13	0.25	Hanumangarh (Rajasthan)
Man-hr/ha	8.0	4.0	
Cost of operation (Rs./ha)	1,232	757	
	Disc Harrow	Rotavator	
Capacity/output (ha/hr)	0.64	32.2	Ahmednagar & Nandurbar (Maharashtra)
Man-hr/ha	61.50	17.92	
Cost of operation (Rs./ha)	420.63	630	
	Ploughing + Harrowing	Rotavator	
Capacity/output (ha/hr)	0.31	2.28	Guntur, Krishna & Kurnool (Andhra Pradesh) Jalna, Ahmednagar, Buldhana, Dhule, Washim (Maharashtra)
Man-hr/ha	5.05	238.88	
Cost of operation (Rs./ha)	1000	970	
	Traditional Cultivators	Rotavator	
Capacity/output (ha/hr)	0.53	0.34	Belgaum, Chitradurga, Koppal (Karnataka) South 24, Parganas (W.B.)
Man-hr/ha	47.6	3.04	
Cost of operation (Rs./ha)	2344	2200	

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Hand Operated Weeders :

Four types of hand operated weeders were demonstrated. The details and performance are as follows. Multi tyne weeder performs better than others in terms of man-hr/ha, cost of operation and weed control.

Efficiency Indicators	Traditional Bullock driven harrow followed by hand weeding by Khurpi	Improved Hand Operated Weeders			Centres
		Peg weeder	Multi Tyne weeder	Star weeder	
Field Capacity/output (ha/hr)	0.1	0.008	0.02	0.015	Salem (Tamilnadu), Amravathi (D), Amravathi (G) and Akola (Maharashtra)
Cost of operation (Rs/ha)	1775	1480	1350	1450	
Man-hr/ha	260	136	50	67	
Total weed biomass kg/m ² (Before)	0.8	0.8	0.90	0.90	
Total weed biomass kg/m ² (After)	0.035	0.015	----	---	

Traditional Practice



Inter-cultural operation by Bullock Driven Harrow

Improved Practice



Inter-cultural operation by Peg Type Weeder

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Weeding Implements

Power Weeder

It is revealed from the demonstrations of power weeder that, this implement was used mainly in South Indian centres (11) and Western Indian Centres (7). It was clear that man-hour requirement was reduced to 6 times with the use of power weeder with slight reduction in cost of operation (Rs 52). The output was more in improved one. The major finding was that total weed biomass with power weeder was 48.06 kg/m² and was decreased to 6.86 kg/m², where as, in case of traditional weeder biomass was decreased from 28.03 to 2.20 kg/m². Thus, power weeder may become an integral part of integrated weed management program in cotton.

Efficiency Indicators	Traditional	Improved	Centers
	Bullock Hoe	Power Weeder	
Power weeder Capacity/output (ha/hr)	0.1	0.11	Belgaum (Karnataka), Coimbatore, Madurai, Perambalur, Salem, Tirunelveli, Vellore, Villupuram, Krishnagiri, Vinudhunagar (Tamilnadu)
Cost of operation (Rs./ha)	357	305	Braruch, Banaskantha, Vadodara (Gujarat), Guntur (Andhra Pradesh), Amravathi, Beed, Nandurbar, Buldhana (Maharashtra)
Man-hr/ha	10	8.8	
Total weed biomass kg/m ² (Before)	28.03	48.06	
Total weed biomass kg/m ² (After)	2.20	6.86	

Traditional Practice



Inter-cultural operation by Bullock Driven Hoes

Improved Practice



Inter-cultural operation by Power Weeder

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Traditional Practice



Tillage operation by Cultivator

Improved Practice



Tillage operation by Rotavator



Tillage with Rotavator

Sub Soiler

Cultivator, Disc Plough and Sub Soiler were compared and it was found that Sub-Soiler performed better in respect of output and man-hr/ha however, the cost of operation/ha was more in the improved implement

Efficiency Indicators	Traditional		Improved	Centers
	Cultivator	Disc plough	Sub Soiler	
Capacity/output (ha/hr)	3.5	5	10	Perambalur (Tamil Nadu)
Man-hr/ha	3.51	5	10	
Cost of operation (Rs./ha)	1,050	2,000	3,000	

Mechanized Rotary

The use of mechanized rotary was found superior in all aspects over traditional method. The capacity is doubled whereas man-hrs. and cost of operation is half in rotary tillage.

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Efficiency Indicators	Traditional	Improved	Centres
	Cultivator	Rotary	
Capacity/out put (ha/hr)	0.03	0.06	Karimnagar (Andhra Pradesh)
Man-hr/ha	30.00	16.00	
Cost of operation (Rs./ha)	2800	1400	

Tractor Drawn Mould Board Plough

Tractor drawn mould board plough was better in terms of capacity and man-hour requirement. Where as, in terms of cost of operation, traditional method was cheaper.

Efficiency Indicators	Traditional	Improved	Centres
	Bullock ploughing	Tractor drawn MB Plough	
Capacity/out put (ha/hr)	0.11	3.53	Karimnagar (Andhra Pradesh) Ahmednagar (Maharashtra)
Man-hr/ha	9.5	09.11	
Cost of operation (Rs./ha)	400	1171	

Traditional Practice



Bullock ploughing

Improved Practice



Tractor drawn MB Plough

Bullock Drawn Ridger

Bullock Drawn Ridger performed slightly better in terms of man-hr/ha and cost of operation.

Efficiency Indicators	Traditional	Improved	Centres
	Hoe with tied rope	Bullock drawn ridger	
Capacity/out put (ha/hr)	0.1	0.133	Nandurbar Buldhana (Maharashtra)
Man-hr/ha	10	7.5	
Cost of operation (Rs./ha)	313	234	

Traditional Practice



Hoe with tied rope

Improved Practice



Bullock Drawn Ridger

Tractor Drawn Disc Harrow

The output of improved Tractor Drawn Disc Harrow was far superior than traditional Bullock Drawn Harrow. The man-hr/ha for traditional bullock drawn harrow was 24.5 more as compared to improved implement.

Efficiency Indicators	Traditional	Improved	Centres
	Bullock drawn harrow	Tractor drawn disc harrow	
Capacity/out put (ha/hr)	0.0375	0.4	Nandurbar (Maharashtra)
Man-hr/ha	27	2.5	
Cost of operation (Rs./ha)	844	650	

Traditional Practice



Bullock Drawn Harrow

Improved Practice



Tractor Drawn Disc Harrow