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*Research Paper :*

# Mechanization of cotton crop production in India

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## ABSTRACT

In context of increasing commercialization of agriculture, mechanization is very important. There has been increase in the use of farm machinery in Indian Agriculture as it contributed to the increase in output due to timeliness of operations and increasing precision in input application. The present study describes the availability of machinery, in India, for the mechanization of cotton cultivation for operations *viz.*, seedbed preparation, sowing and planting, inter-culture, plant protection and harvesting. Energy requirement for different operations for cotton cultivation in conventional and using improved practices are described. Evaluation was carried out using traditional method of cultivation in comparison with improved practices on cost of operation and energy requirement. It revealed that improved machines consume less energy as compared to its traditional counter part.

**Key words :** Mechanization, Timeliness and energy requirement

Farm mechanization has been helpful to bring about a significant improvement in agricultural productivity. Thus, there is strong need for mechanization of agricultural operations. The factors that justify the strengthening of farm mechanization in the country can be numerous. The timeliness of operations has assumed greater significant in obtaining optimal yields from different crops, which has been possible by way of mechanization.

Cotton is one of the principle commercial crops in India. India ranks first in the World in area under cotton cultivation (8.76 million hectare), while in term of production this ranking is third at 11.64 million bales (170 kg each). In fact the average yield of cotton is very low and it is around 226 kg/ha as against the average yield of 584 kg/ha in the World as most of the operations in the cultivation of cotton are done in a traditional way involving lot of labour force. In India only 35.8 per cent of area under cotton crop is irrigated (Yadav and Kumar, 2002).

Better cultivation practices, plant protection measures and balanced dose of fertilizers play a significant role in augmenting the yields. Nevertheless, the adoption of advance processes and improved implements are equally important. Mechanization alone would enable multiple cropping programme resulting in greater employment potential in the long run by the repair, servicing and maintenance of farm machines and tractors (Goyal *et al.,* 1979). Mechanization of agriculture has become one of the most critical requirements but this is one of the factors that contribute to high yield. Almost mechanization of cereal crops has been achieved in the medieval period of green revolution. The farmers in the country are still using the traditional methods of cultivation of cotton crop, which leads to considerably low productivity. The cotton is mostly drilled manually or behind the '*desi'* plough. The seed rate is very high. After germination the plants are thinned to maintain the required number of plants per hectare, which is highly labour intensive. Thinning is also essential to provide necessary aeration and light to the crop. In some cases tractor-drawn drills are used for sowing cotton seeds and crops are thinned later. Farmers are now started using seeds of high yielding varieties, which are very costly and can not be sown by traditional way of sowing otherwise cost of production will increase. Mechanical interventions can be made through mechanization of tillage, planting, interculture and 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. Precision farming aims at providing a variable rate application of inputs according to locally determined spatial variables at farm level.

## METHODOLOGY

Following implements and machinery are being used for cotton crop production *viz.*, rotavator, tractor drawn pneumatic cotton planter, tractor drawn inclined plate planter/vertical roller type planter, cultivator with modified sweeps, inter-cultivation, cultivator with modified sweeps, self propelled power weeder, plant protection operation, power tiller operated boom sprayer, cotton stalk shredding

and uprooting, tractor operated roto slasher, tractor operated plant puller, engine operated stalk chipper.

## RESULTS AND DISCUSSION

The traditional farm tools and implement mainly relied on use of animate power. Improved farm tools, implements and machinery, which use both animate and mechanical power were devised from time to time. The average size of farm holding being small, animate power is widely used in many parts of the country. Mechanical power is making its impact in Indian agriculture with steady increase in land and labour productivity. The different implements required for cotton crop cultivation are described as below.

### Seedbed preparation:

Mechanical power hastened seedbed preparation and timely sowing of crops. The seedbed preparation and planting operation contributed nearly 20 per cent of energy required from sowing to marketing and hence the choice of type of implements for planting and seed bed preparation play a major role for proper establishment of crop. The seedbed must ensure proper germination of seed and effective utilization of water.

### Rotavator:

At present the most widespread method of tilling land is harrowing with disc harrow and/or followed by cultivator operation. In the process of ploughing, the soil layer is subjected to various deformations and is turned to the bottom. However, with this equipment, the upper layer of soil is not always loosened to the desired extent, nor is the proper mixing of the different layers achieved. The tilling machines with rotary working parts impart high quality to the layer worked because of the cutting of a comparatively thin layer from the soil monolith. A rotary tiller called the rotavator uses power driven rotor to replace the conventional tillage implements. This powered working tool receives rotational motion from the tractor power take off shaft (Fig. 1).

### Sowing and planting:

Establishing proper plant stand is the most crucial requirement for cotton crop. With the improved methods and tools of seed bed preparation and planting consequently increased in cost of operation but planting accuracy also increased which resulted in proper establishment of crop and saving in costly seed.

### Tractor drawn pneumatic cotton planter:

Three row and six row tractor drawn pneumatic cotton planters were designed and developed at Central

**Fig. 1 : Tractor drawn rotavator**

Institute of Agricultural Engineering, Bhopal. Pneumatic planting is a new concept over the traditional planting machines. Metering of seeds carried out pneumatically. Cotton crop is wide spaced and heavy feeder, its accurate and precise planting is possible with this planter. The full capacity of the tractor power could be effectively utilized and also gives higher field capacity (Fig. 2).

**Fig. 2 : Tractor drawn pneumatic planter**

### Tractor drawn inclined plate planter/vertical roller type planter:

Tractor-drawn inclined plate planter and tractor-drawn cotton planter with vertical roller type metering device was designed and developed at PAU, Ludhiana and evaluated for planting of cotton crop. Both the planters were found satisfactory to maintain proper plant stand. Animal drawn CICR Cotton planter: It was developed at Central Institute for Cotton Research, Nagpur specially for planting of cotton in vertisole. Cup type metering mechanism is used. Planter was tested successfully at CICR, Nagpur and in the farmer's field also. Equipment was found suitable for small and marginal farmers (Fig. 4).

Fig. 3 : Self-propelled rotary power weeder

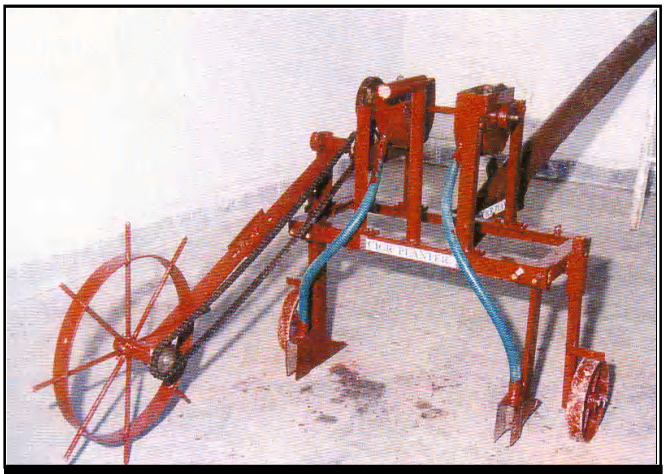

Fig. 4 : Animal drawn CICR cotton planter

**Inter-cultivation:**

Inter-culture is a most important operation in increasing our agricultural productivity and profitability. Inter-culture is usually done in sitting/ bending postures, which induces maximum fatigue during work. New improved and efficient tools was developed and evaluated for weeding in cotton crop.

Cotton is a heavy feeder crop and requires larger unit area per plant for proper growth, which results in more weed. Weeding in cotton is a very costly, laborious and a time consuming operation. To mechanize this operation investigations have been carried out with various tractor operated as well as power tiller operated equipment.

**Cultivator with modified sweeps:**

Tractor mounted cultivator with modified sweeps was developed at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola and was evaluated for inter-cultivation in cotton crop. The equipment was found quite satisfactorily as interculture equipment. The farmers can use this equipment for both tillage as well as interculture operation by changing the working tool (sweeps) only.

**Self propelled power weeder:**

Three hp petrol start, kerosene run engine operates the weeder (Fig. 3). The engine power is transmitted through ground wheels through V-belt pulley and sprocket chain mechanism. At the back of the machine replicable sweep blade is fixed. The machine is useful for weeding between row crops like cotton, maize, pulses and tomato.

Plant protection operation: A commonly available manually operated knapsack sprayer (LOK) is using throughout the country despite the use of high cost and heavy machines. Besides the use of large tractor operated machines medium range equipments (self propelled engine operated and power tiller operated) were designed and developed.

**Motorized knapsack sprayer (Mist blower):**

The shoulder mounted motorized sprayer is the very versatile plant protection equipment. The spraying liquid is blown out through the primary unit by means of an intensive air current generated by the unit. The air current attains a velocity of 170 miles per hour at the nozzle. A part of the air generated by the blower is diverted into the chemical tank to form air cushion over the liquid within the tank to ensure uniform delivery of the liquid. The outlet from the chemical tank is through PVC tubing reaching the nozzle on the spray lance. The flow of the liquid is partly by gravity and partly by the air pressure exerted over the liquid within the tank. For spraying the chemical different nozzles provided to suit the required flow rate. A cut off device is provided in the nozzle. For spraying on the plants, which are nearer to the operator, swath can be adjusted with swath adjuster provided in the nozzle.

**Self propelled high clearance sprayer:**

It is a self propelled unit suitable for spraying for tall and wide spaced crops. This four wheel riding type machine consist of two rear steered wheels, two front lugged wheels powered with a 20 hp diesel engine through a gear box, tank, hydraulic pump and bottom fitted with 15 nozzles. It saves 15-20 per cent labour and operating time and 30 per cent cost of operation.

**Power tiller operated boom sprayer:**

This is a spraying system mounted over power tiller, which is used for spraying in row crops as cotton. The boom is fitted at the front of the power tiller having total width of 6 m. The chemical tank is an integral reinforced fiber glass tank of 100 liter capacity. The boom is provided

with hollow cone nozzles (10) fitted on a boom having discharge rate 0.73 l/min while the application rate 500-600 l/min.

**'*Bramha*' animal drawn sprayer:**

It is an animal operated sprayer particularly for tall and wide spaced crops as like cotton. The sprayer has to move 100-200 ft. to develop the operating pressure of 4-5 kg prior to go in field. On the forward movement of the sprayer, it develops the pressure in pressure tank, which is also kept near to spray storage tank. A single man can easily operate this sprayer. There is provision for hand priming and actuating the pump before moving in the field for uniform spray.

**Cotton stalk shredding and uprooting:**

The conventional methods of removing the cotton stalk either by cutting with sickle or using a hand puller is time and labour consuming one. The stalk left in the field by the manual cutting cause injury to the feet of animals and of the operators. The pulling of cotton stalk by hand is difficult, as it requires an average pulling force of 903 N. The migration of labour to various scholastic jobs makes the cotton stalk removal as a tiresome operation. Hence, to reduce the drudgery of the human labour in cotton stalk pulling and also to enhance the utility of tractor, several models have been developed.

**Tractor operated roto slasher:**

A tractor operated rotary slasher is used for slashing of cotton stalks. The implement consists of mounting, transmission system, gearbox, blade, beam and body. It is operated through PTO shaft. Roto slasher operation for shredding cotton stalks resulted in 86.63 and 96.29 per cent saving in cost and time, respectively when compared to conventional method of pulling cotton stalks.

**Tractor operated plant puller:**

The plant root details play an important role in uprooting the stalk. This is tractor operated equipment designed and developed at TNAU, Coimbatore. The pulling efficiency was found to be 97.96% at the forward speed of 3.2 km/h and average draft was recorded as 325 kg. It can also be used for pulling stalks of castor and arhar crop (Anonymous, 2002 and 2003).

**Engine operated stalk chipper:**

An engine operated stalk chipper was designed and developed at Gujrat Agricultural University. The Machine is fed large size of stalk as in case of chaff cutter. Along wheel fitted with chipping blades chips out the wooden pieces can be used in strobes for burning and also can be spread over the field which rots during rain add humus to the soil.

Field performance of the traditional implements and improved implements required for cotton cultivation is given in Table 1 and 2, respectively.

**Conclusion:**

Paper revealed the possibility of mechanization of cotton cultivation in India. Although the machinery have been developed and found suitable for cotton cultivation some machines may not be affordable by our farmers. The only way is that World Bank and Government should come forward to make available these machines at least at a co-operative basis.

**Table 1 : Traditional cotton cultivation implements**

| Sr. No. | Operation | Type of implement | Field capacity ha/h | Field efficiency, % | Energy requirement hp-h/ha | Cost of operation Rs/ha |
|---|---|---|---|---|---|---|
| 1. | Seed bed preparation | *Deshi* plough | | | 216.7 | 1390 |
| | | Animal drawn harrow | | | | |
| 2. | Sowing | Manual (dibbling) | | | 25 | 2300 |
| | | Single row cotton drill | | | | |
| | | Seeding behind the plough | | | | |
| 3. | Inter-cultivation | Manual (*Khurpi*) | - | - | | 4050 |
| | | Bullock drawn junior hoe | 0.058 | 50.9 | 3280 | 862.07 |
| | | Bullock drawn blade hoe | 0.113 | 63.12 | | 369 |
| 4. | Plant protection measures | Manually operated knapsack sprayer (LOK) | 0.016 | | 265 | 238 |
| 5. | Stalk disposal | Hand pulling | 0.042 | | | 214 |
| | | Manually operated *chimta* | 0.043 | | | 446 |

**Table 2 : Improved implements used for cotton cultivation in India**

| Sr. No. | Operation | Type of implement | Field capacity ha/h | Field efficiency, % | Energy requirement hp-h/ha | Cost of operation Rs/ha |
|---|---|---|---|---|---|---|
| 1. | Seed bed preparation | Tractor drawn rotavator | 0.25-0.5 | 91-98 | 140 | |
| | | Cultivator | 0.74 | | | 371-400 |
| 2. | Sowing | Tractor drawn pneumatic cotton planter | 0.8-1 | 65.5 | 43.75 | 563.13 |
| | | Tractor drawn inclined plate type planter | 0.35 | 76 | 100 | |
| | | Tractor drawn vertical roller type planter | 0.26 | 67 | 134 | |
| | | Animal drawn CICR Cotton planter | 0.2-0.5 | - | 5.5 | |
| 3. | Inter-cultivation | Tractor mounted cultivator | 0.69 | 76.45 | 50.72 | 377 |
| | | Power tiller operated weeder | 0.076 | 79.83 | 39.47 | 55 |
| | | Self propelled power weeder | | | | |
| 4. | Plant protection measures | Motorize knapsack sprayer | 0.32 | | | |
| | | Self propelled high clearance sprayer | | | | |
| | | Power tiller operated boom sprayer | 3.77 | 75.32 | 3.97 | 27.50 |
| | | *Bramha* animal drawn sprayer | 0.06 | 50 | 16.66 | 85 |
| 5. | Stalk disposal | Tractor operated roto slasher | 1 | 96 | 35 | 390 |
| | | Tractor operated plant puller | 0.98 | 80 | 35.71 | 665 |
| | | Tractor drawn V-blade | 0.40 | 99 | 87.5 | 620 |

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