Title: Mechanization 01 Colton Produclion

Code No.	TMC/MMI/2.3	
Year	2007-08	
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INTRODUCTION

The project on Mechanization of Cotton Production under TMC MM-I was undertaken to save the cost of different operations and to ease the peak labour shortages. Timely operations with reduction in drudgery to human labour can be achieved through the use of improved implements.

OBJECTIVES

1. Development and evaluation of improved implements for cotton production.
2. Evaluation of mechanical cotton picking on new cotton genotypes
3. Standardization of defoliation process as an aid to mechanical picking
4. Development and evaluation of cleaning machinery for mechanically picked seed cotton

ACTIVITIES

The implements/ machines developed and refined at various research institutes and Universities viz. Pneumatic cotton planter, Tractor operated belt type seed metering planter for cotton, tractor operated inclined plate planter, tractor-operated air-assisted sprayer, self-propelled cotton weeder, power tiller operated gaseous energy sprayer, power-tiller operated boom sprayer, tractor-operated cotton stalk pUller, Tractor drawn weeding cum earthing-up equipment etc. which need to be popularized and commercialized. Many cotton implements are in the developmenVrefinement prototyping stages, which need to be refined and brought for use by cotton farmers. New implements to be developed based on gap analysis and evaluated, refined and demonstrated on farmer's fields. Agronomic and defoliation requirements for machine picking of cotton will be studied. The machine parameters needed for machine harvesting will be worked out and suitable pickers for Indian farms will be designed and developed.

EXECUTIVE SUMMARY

For sowing & planting of cotton, a self-propelled check row planter has been designed, developed and fabricated. A bullock drawn precision planter has been developed and evaluated for cotton sowing. Happy seeder has been modified for Bt. Cotton sowing which will be evaluated in coming season.

For inter row cultivator of cotton a self propelled precision was evaluated in cotton crop. Field capacity of 0.3 ha/hr with 75-86 % weeding efficiency could be realized. Rotary spading machine for inter-row cultivation in cotton was refined by providing clod breaker trailing boards. Several commercially available weeders were evaluated fortheir suitability in cotton.

Several cotton varieties & Bt. Hybrids were evaluated for suitable plant characteristics amenable to mechanical picking. The effect of spacing and different defoliants like Dropp, Roundup & Ethrel was studied on the percent defoliation of cotton leaves.

Tractor mounted as well as knapsack type pneumatic pickers were modified/evaluated in picking cotton under field condition. The cost of picking with these aids worked out more than manual picking. Effect of different suction pressures and

picker valve diameter were studied on picking efficiency, trash content & output capacity.

Two-row cotton stalk up-rooter was modified & it was evaluated with variable widths of rotating wheels, peripheral speed & forward speed. An enhanced uprooting efficiency of 71% could be achieved at 7.91 m/s peripheral speed & 265 mm width of pulling wheel at 1.6 km/hrforward speed.

Location specific implements were developed to cater to specific category of a farmer or of a region; viz animal drawn adjustable hoe, ridger, bund former for small farms and tractor operated subsoil coir pith applicator for subsoil mulching with coir pith in cotton, for southern cotton growing region.

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SALIENT FINDINGS

Development and Evaluation of Sowing/Planting Equipments Design Development of Self propelled Check row planter

A 3-row, self-propelled check row planter with pneumatic metering mechanism is under development and evaluation (Fig. 1). In the coming Season this planter will be tested at Cotton Project CRS Akola and Farmers field for Check row planting of Cotton.

Fig. 1: Self propelled check row Planter

Testing and evaluation of self propelled Pneumatic Planter

A self propelled Pneumatic Planter developed under the project was evaluated under field conditions on cotton and other crops(Fig.2). The field efficiency of the pneumatic planter was less in case of Cotton however, due to proper placement of

Fig. 2: Pneumatic Planting

seed, cost saving over traditional was 75%. Actual field capacity was 0.51 ha/h with 88% field efficiency. Cost of operation was Rs. 215/ha which is remarkably less than any other traditional method. Timeliness & preciseness in operation enhanced the productivity. Effortless operation reduced the drudgery of the operator

Evaluation of bullock drawn vertical rotor precision planter:

A bullock drawn precision planter was developed with an innovative vertical rotor metering mechanism having the advantages of reduced seed damage and uniform seed placement (Fig. 3). The planter was tested at CICR farm and the results revealed that the average depth of seed placement was 6 cm below ground with a germination percentage of 84 % and a seed rate of 5.2 kg/ha. The field capacity of the implement was 4.5 hrs/ha.

Fig. 3: Precision Planter

Evaluation of inclined plate planter and happy seeder for Bt cotton

Happy Seeder has been developed at PAU for sowing wheat in paddy residue. An attachment for planting cotton using Happy Seeder in wheat residue has also been developed.

B. WEEDING/INTERCULTURE EQUIPMENTS

Development and evaluation of self propelled precision inter row cultivator

A self-propelled inter row cultivator was developed and tested in cotton and other crops (Fig. 4). In cotton it was tested in check row of 60 x 60 cm. The inter row cultivation was done twice in the row cotton Two way in check row cotton and in the sunflower setting was done in first & second operation in the cotton. The speed of operation was found 2.85 to 3.2 km/hr which was most suitable for the operator. The actual field capacity was found 0.25 to 0.3 ha/hr with 48 to 98% field efficiency. The weeding efficiency was 85 to 86%. The operation cost was found as Rs. 303 to 360 per hectare. In spite of quality work the cost of operation was near traditional hoe.

Fig. 4: Inter row cultivator

Evaluation and refinement of rotary spading machine for inter cultivation in cotton

Fig. 5: Spading Machine

The spading machine (Fig. 5) developed previously underTMC, was refined by modifying the pivot assembly and providing clod breaker trailing boards. The spading machine was field tested in cotton crop cultivated in normal practice and was found to do the inter cultivation with minimum crop damage. The spading machine can be effectively used in cotton raised in flat beds at a spacing of 60cm to 1m.

Performance Evaluation of weeders in cotton crop

A Tractor operated three row rotary weeder along with two commercially available self propelled machine used for weeding purposes viz RPW-1 with a 4.8 hp diesel engine and RPW-2 with a 6.5 hp petrol engine, riding type (Fig. 6) were

Fig. 6: Rotatory weeder

evaluated for weeding in cotton. Performance of the machines was satisfactory. Weeding efficiency was about 94-95% for both self propelled weeders as compared to 90% for tractor operated rotary weeder. However, the field capacity was less for the former. Injury to plant was 1-3 percent.. Saving in cost and labour was 30-40 percent and about 90 percent as compared to manual weeding. Three power weeders viz., Oleo Mac, TNAU-Varun and Balram weeders were found to be suitable for weeding between rows of cotton crop planted at a row spacing of 1 m. The Oleo Mac power weeder can weed one hectare in 12 hours while the Balram and TNAU-Varun can weed one hectare of cotton field in 15 hours, when the weeders were used to make one pass between the rows. The weeding efficiencies of power weeders ranged from 65-75% while the efficiency of manual weeding was around 95%

C. Genotype Selection For Mechanical Picking And Study Of Defoliants

Study of varietal characteristics of promising bt cotton varieties with reference to their suitability for using modern cotton pickers

The plant characteristics data of BT cotton hybrids RCH-134, Ankur-651 and Manak were collected. The recommended row to row spacing was li7.5 cm and plant to plant spacing was 90 cm. From the characters studied Manak appears to be more

compact and suitable for mechanical picking as compared to RGH-134 & Ankur -651.

Identification of suitable genotypes for mechanical picking:

Four popular genotypes of central india namely, PKV 08, Khandwa-2, G cot 16, and NH 452 at three spacings 90x1 0, 90x20 and 90x30 cm were planted to study the effect of closer spacing on plant characteristics affecting mechanical picking. G.Got 16 was found to be most compact and suitable genotype amenable to mechanical picking among the varieties tested.

Evaluation of different defoliants for their suitability to mechanical picking of cotton

Three defoliants namely Dropp (Thidizuron) (50% WP), Roundup (41 % SL) & Ethrel (39 % SL) were applied at 1% concentration over varieties PKV 081, Khandwa-2, G cot 16, and NH 452 with three different spacings 90x10, 90x20 and 90x30 cm to study the effect of varieties and spacing on defoliation.

Among the four varieties tested, variety Khandwa-2 gave max. % defoliation i.e. 78 percent which was significantly superior over all other varieties. Various spacing did not show any significant difference among them in respect of percent defoliation. Ethrel gave maximum percent of defoliation (73%) and was statistically at par with Dropp (71%). Defoliant 02 (Round up) recorded less 60 % of defoliation.

D. DESIGN AND DEVELOPMENT OF COTTON PICKING AID

Development of tractor mounted pneumatic picking aid for enhancing efficiency of manual picking of Bt cotton varieties

The concept of cotton picking aid is to use the suction valve to pick the cotton bolls (Fig. 7). The valve could be opened and closed with the hand operated lever. The main objective to

Fig. 7: Pneumatic Picking aid on tractor

install a open/close valve was to minimize human effort and to avoid the trash content which generally comes

with mechanical picking of cotton crop. When the valve gets opened, an air suction is developed at the picking end due to which cotton bolls get picked. A cyclone separator cum collector was designed and used to collect the picked cotton. Different picker end diameter had been used to get different suction pressure at picking end of the machine. F1861 American cotton variety was used for the different suction pressure and picker valve diameter combination to study their effect on the picking efficiency, trash content and output capacity. Picking efficiency and output capacity were highest (96.3%, 6.21 kg/h) at 25 mm picker end diameter with suction pressure of 45 mm of Hg. The trash content was minimum (0.65 %) at 20 mm picker end diameter with suction pressure of 30 mm of Hg and was highest (5.64 %) at 40 mm of picker end diameter with suction pressure of 28 mm of Hg. Trash content increased with increase in picker end diameter. Trash content at 25 mm of picker end diameter was not significantly different from 20 mm picker end diameter but the picking efficiency and output capacity were highest at 25 mm of picker end diameter.

Development of Knapsack type pneumatic picking aid for enhancing efficiency of manual picking of Bt cotton varieties

The Knapsack pneumatic picker developed by TNAU (Muthamilselvan,2002) was field tested and was found to pick RGH 2Bt cotton efficiently (Fig.8). Two persons were required to operate the pneumatic cotton picker and it is possible to reduce one person by keeping the unit on the ground. The pneumatic cotton picker could pick an area of 0.45 m2 lmino i.e around 5 minutes to harvest from one plant. Picking cotton with pneumatic cotton picker resulted in 38% reduction in labour requirement over manual picking if operated by one operator. The losses during harvest was 3% in case of pneumatic picker as against 2.5 % in manual harvesting.

Fig. 8: Knapsack type pneumatic picker

The cost of harvesting works out to Rs.11.96 per kg for pneumatic picker as against Rs. 2.75 for manual picking

E. COTTON STALKS INCORPORATION

Evaluation and refinement of tractor operated hydraulic cotton stalk puller

A hydraulic cotton stalk up rooter had been designed,

Fig. 9: Hydraulic Cotton Stalk Puller

developed and tested at Departmental research farm using 35hp/45 hp tractors (Fig. 9). It was tested for three peripheral speed, three travel speed and three tyre width. Three peripheral speeds (rotational speeds) of the pulling wheel used were 5.86 m/s (200 rpm), 6.88 m/s (235 rpm) and 7.91 m/s (270 rpm). Variation in peripheral speed (rotational speed) of the pulling wheel could be achieved by changing the pulley sizes of 9 inch, 8 inch and 7 inch respectively on sub-main shaft of the machine. Three width of pulling wheel used were 165 mm, 185 mm and 205 mm. Three levels of forward speed of the machine were 1.6 km/h, 2.5 km/h and 3.6 km/h. The two forward speeds of 1.6km/hr and 2.5km/hrwere obtained by using 35hp tractor at first and second low gear respectively and the remaining third forward speed was obtained by using tractor of 45 hp at first low gear. At the end of each experiment, observations i.e. number of plants uprooted, number of broken plants were recorded. Highest plant pulling efficiency of 71.22% could be obtained at 7.91 m/s peripheral speed and 205mm width of pulling wheel at 1.6 km/h forward speed of operation. Minimum plant breakage was found observed at 5.86m/s peripheral speed and 205mm width of pulling wheel at 1.6 km/h forward speed of operation. The plant pulling efficiency and plant breakage increased with increase in peripheral speed of pulling wheel and forward speed of tractor respectively. It can be concluded that to get best performance of the machine, it should be operated at 7.91 m/s peripheral speed, 205mm width of pulling wheel and 1.6 km/h forward speed.

F. DEVELOPMENT OF LOCATION SPECIFIC IMPLEMENTS

Development of improved small farm equipment for cotton farmers:

Improved bullock drawn implements were developed for increasing the efficiency of small and marginal cotton farmers.

Adjustable hoe: Bullock operated hoe for inter culture operation in cotton cropping system. Various sizes of blades (9", 12" & 18") can be accommodated in a frame, with quick coupling and decoupling.

Ridger: For making ridges in between the rows of cotton for moisture conservation in soil and to act as a channel for irrigation. It can also be used for creating ridges and furrows before sowing.

Bund former: This equipment can be used for making bunds in the fields to facilitate easy surface irrigation.

Iron plough with sowing attachment:. For primary tillage operation of ploughing and sowing of rabi crops like gram.

Evaluation and refinement of tractor operated subsoil coir pith applicator for cotton

An experimental subsoil coir pith applicator for control application of coir pith at different depth was developed (Fig. 10). A completely randomized field trail to evaluate the influence of mulch material, application rate and depth of mulching on crop performance has been laid out and biometric and soil moisture profiles are under observation. The preliminary results show that there is a favorable response to

Fig. 10 : Subsoil coir pith Applicator

crop growth due to application of subsoil mulch. The moisture profile and soil strength profiles show the favorable results of the mulching operation. The cost of the subsoil coir pith applicator is Rs. 10000 and the cost of operation for subsoil mulching for one hectare is Rs. 6800.

G. CLEANING SYSTEMS FOR MACHINE PICKED COTTON

Development and Evaluation of Cleaning Machinery for Mechanically picked seed cotton.

The stick machine and saw band type cleaner developed for cleaning the seed cott6n before ginning, earlier were efficiently removing the cut seeds, short fibers, motes, soil particles, but, it did not remove the leaf trash effectively because of more leafy trash in machine picked cotton. Hence necessary modifications in the machine are being incorporated which can remove the leafy trash effectively.