Mechanization Tools in Groundnut cultivation

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I. Primary tillage for groundnut

Groundnut crop requires better till and congenial environment to extend roots proliferate crop, but majority of farmers till the land with cultivator irrespective of crop grown and some of the farmers do with retovators which are basically secondary/intercultural equipment. The operation by these equipment cannot break open hard-pan(consolidated soil mass formed due to weathering and machinery movement) crop grown under such environment will restrict its growth to the extent of loose soil. Hence primary tillage is dire essential in groundnut production system. To break open the consolidated soil up to the depth of 30-45cm and to provide soft, friable soil base for progress of plant growth use of primary tillage implements is essential.

1.1. Mould Board Plough

It is useful in preparing field up to 45cm, turned and pulverized. The MB plough enters in to the soil due to suctions in configuration and is 300 % efficient when compared to Bullock drawn country plough or cultivator. The implement can efficiently be used in stone free, non sticky soils. To avoid undulations in the field, two way reversible Mould board ploughs are available which can be operated with hydraulic shift lever.

1.1 Mould board plough

1.2 Disc Plough

1.2. Disc Plough

In stony stumpy soils, where MB plough cannot be administered Disc plough can be successfully administered. This plough has got rolling plough bottom, hence it is useful for any type of soils and plough enters in to the soil due to self weight of the implement. If required, dead weights can be added to the implement for more depth up to 45cm even in dry soils. The rolling discs orientation like disc angle and tilt angle be changed for getting better quality soil tilt.

The research results on root development studies infers that groundnut can extend its roots up to 2.1 m (Sudhakar,et.al., 2010) under favorable root environment system. Hence to provide favorable root growth environment the field must be prepared to the possible depth. This not only envisages better root growth but also aids in in-situ moisture conservation. Similarly studies on the effect of primary tillage (MB plough and rotovator) on groundnut growth parameters revealed that there is an increase of 14.5 percent yield growth over farmers' practice i.e., cultivator and rotovator used for preparatory cultivation Ramana.C 2015. Moreover, depth of cut and disturbance of soil will provide better exposure to nutrients and moisture therein productivity enhancement is made easy

1.3. Sub Soiler

Sub soiling i.e., cutting soil strata up to the depth of 40-75cm on the field, makes vertical cut and administered once in three years to manipulate lower layers of soil strata and aids in adding new soil with old soil on top layers. But the sub soiling (vertical tillage) is also creates vertical trough for entry of rain water received in that field and lateral movement of excess water as runoff is restricted. The entry of rain water in deep layers through vertical cuts will moist soil below surface and be intact (as reservoir) without getting evaporated. Moisture below surface layers help crop to sustain even in long periods of dry spell and insures the crop. This phenomenon of entry of rain water in to the deep layers minimizes surface runoff, thereby minimizing transportation of fertile top-soil, remains in the same field (protecting soil against erosion). Deep layer tilling through sub-soiling also envisages the plant to develop deep roots and accessed to preserved moisture and more volume of soil nutrients.

Experiment results also shown that there is less disease (collar root rot) instance, even in prolonged dry spell with sudden down pour (precipitation) recorded in sub-soiled field, but whereas complete damage due to collar root rot in un-treated fields (shallow ploughing was done) of groundnut, this is mainly due to moisture presence in the field soil where Sub-soiling is administered (Ramana. C, 2014).

Hence usage of primary tillage during summer not only improves the productivity but also reduces pest and disease complex, field preparation with primary tillage implements can improve production of up to 12% in the rain fed and 15-18% in irrigated dry crop situation.

1.3 Sub soiler

II. Secondary tillage

Act of primary tillage, ploughing to a depth of 45cm will cut , invert and to some extent pulverizes soil, which handles more mass of soil and makes the field undulating (with soil clods). The cloddy and undulating conditions is not congenial for sowing process, since even soil contact with seeds could not be established germination initiated in the undulating field conditions. Hence to make the field ready for seed bed (soil) need to be further processed/pulverized and requires a special type implements like disc harrow, spike toothed harrow, blade harrow etc.

2.1. Rotovator

This is an active implement and gets the power from PTO shaft of the tractor and rotates horizontally mounted central shaft on which soil working tynes are mounted and cuts the soils clods. The action of Rotovator on the already ploughed land makes friable and soft. This action of pulverizing soil automatically fills pores with air (pockets) in to the soil system and be useful for plant & root growth. Since the Rotovator consists of door in the rear to adjust clod size of the soil in the operation and it also helpful in making field level and clod free.

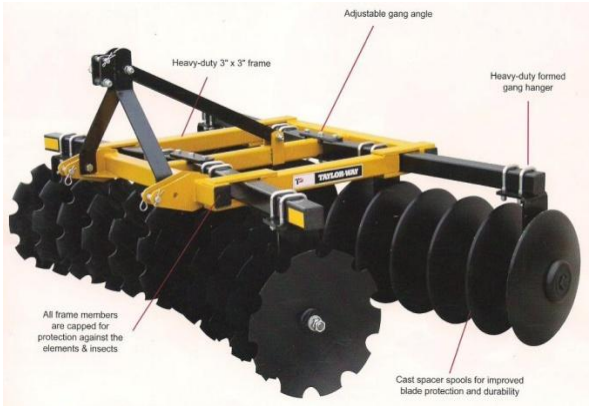
2.2. Power Hoe

This is an active tool and gets the power from the tractor PTO to rotate the vertically (independently) mounted tynes in the housing. These tynes are made of high carbon steel and sharpened to generate cutting action on the soil. The rotation of the tynes makes clods in to friable soil. Since the tynes are located vertically the bottom portion of the field will not become hard and puffing action is created.

The soil will become more of air pockets and be very useful for root crops like groundnut, potato, onion etc. The implement is also useful for churning and mixing up of the soil. The rotary hoe also will have door in the rear to make the field level one and be immediately used as seed bed for the crops. The power hoe can complete 0.75-1 acre/hour.

2.3. Disc harrow

The Disc harrow consists of rotating discs as soil working components, it is a passive tool. The implement will have number of gangs on which number of discs mounted with spool and scraper so as to mix the soil thoroughly. The numbers of gangs are 2 or 4 and a disc on the gang varies from 6-18 depending on the size of the equipment. The gangs are provided with two different discs usually in front gang notched type discs and plain discs in rear gang. These discs are mounted on square centered shaft and with some disc, angle (20-23^0) to the line of travel. The arrangement inculcates the rotation when the implement dragged with tractor. The rotation of discs will crush the clods and mixes with two opposite disc gang arrangements. The capacity of the implement depends on number of gangs and discs per gang. Normally it can cover 1 ac/hr.



2.4. Spike tooth harrow

This harrow is used for clod crushing and combing up operation after primary tillage operation. This is a passive implement and does good mixing and crushing with mounted tynes. Some of the spike tooth harrow are mounted with spring tynes which can enter to better depths than ordinary tynes. This tynes are mounted on frame, this implement is better used for cleaning of crop & weed residues from the fields.

2.5. Blade harrow

This is a passive tool and being attached with 3 point linkage system of tractor as integral part. This is used after primary tillage and at the end of secondary tillage operation Blade harrow is fixed with a single blade or double blades to the vertical drops (standards) of frame. Frame consists of the provision to mount on a tractor as a mounted implement. The blade of the implement will cut undulating soil portions beneath the ploughed (or) tilled soil. The scraping of these undulating soil lumps will greatly help in uniform irrigation in entire field and avoid dry patches of crop in the field. The cutting of hidden bumps under soil is very much essential and saves irrigation water up to 10% and provides uniform crop growth & maturity which improves water productivity.

III. Seed treatment equipment

3.1. Seed treatment drum

This is used for thorough mixing of pesticides with groundnut seed before sowing as a plant protection measure. It consists of a drum mounted on a frame at 40^0 with horizontal and operated manually by using a crank handle. It saves 33%labour, operating time and cost of operation over conventional method of mixing manually with land. Its overall dimensions are 900 X 700 X 400 mm and weigh about 25 kg. The drum capacity and mixing capacity are 10 kg and 100 kg/h respectively with mixing efficiency up to 90%.

IV. Sowing equipment

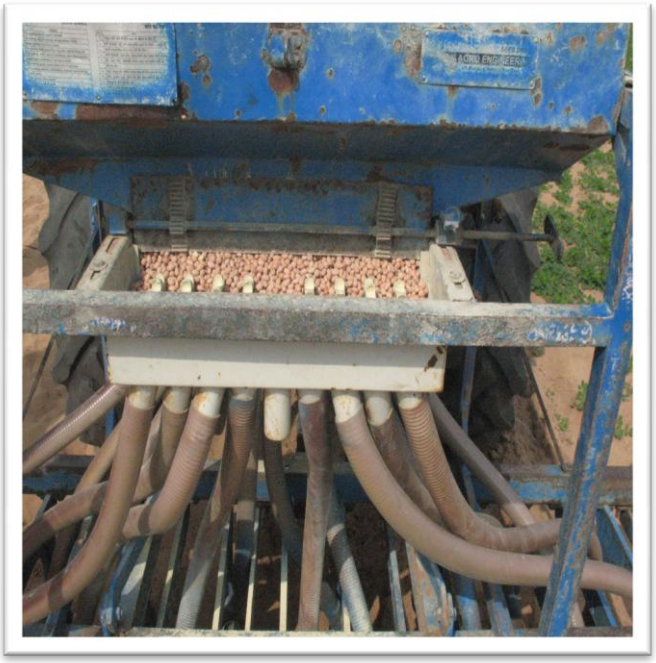
Sowing is a very important operation which has to be performed timely especially in irrigated dry and rain-fed cultivation. The sowing also very important for making complete mechanization like intercultural operation, spraying and harvesting. Since the groundnut kernels are very soft and care need to be taken (not to crush damaged) during sowing. The seed rate also needs to be accurate for maintaining groundnut productivity.

4.1. Sathi bullock drawn groundnut planter

To mechanize the sowing operation by using bullock drawn groundnut planter was designed and developed at Agricultural Research Station, ANGRAU, Ananthapur. It is provided with a trough type seed metering mechanism for seed placement in the row. This covers four rows at a time with row to row distance of 30 cm and maintains seed to seed distance of 10 cm in a row at 4-5 cm depth of sowing. The recommended seed rate i.e. 100 Kg/ha can be maintained. It can also be used for other crops like Bengal gram, castor and red gram by changing the row to row spacing and disc in seed metering mechanism. The field capacity is in between 1.5 to 2 ha/day. The capacity of hopper is 8 kg for groundnut.

4.2. Seed cum fertilizer drill

(Gujarat model): This seed cum fertilizer is provided with seed and fertilizer boxes along with seed metering mechanism (trough feed) and mounted on 9 tynes cultivator (Rigid and spring tyned optional based on soil type). The depth control system was provided to maintain uniform depth through two guage wheels. The row spacing of the sowing can be adjusted as per the season/requirement. The covering device is placed behind the implement to close the furrows immediately after sowing (with rear plank). Similarly the same seed drill can be used for any type of seed sowing for which seed metering scoop wheels need to be changed. Fertilizer drilling qualities also can be monitored by changing sliding door at the bottom of fertilizer box and beginning of the fertilizer spout.



4.3. Tractor drawn Anantha groundnut seed cum ferti drill

Tractor drawn groundnut seed cum ferti drill –row tractor operated groundnut seed drill with row to row spacing of 30 cm fir timely sowing with mechanical advantage and intercropping fertilizer facility is provided. This is provided with a hopper and seed metering mechanism as the main components. The hopper is divided into boxes each can accommodate 5 kg of seed (total 40 kg). the inclined plate seed metering mechanism gives correct seed to seed distance of 10 cm in a row and maintains the recommended seed rate of 100 kg/ha with optimum plant population of 33 per square meter area. Placement of seed is at proper depth of 4-5 cm. the seed damage is negligible and the field capacity is 6 to 7 ha/day and facilitates coverage of large area before the soil moisture is dried up. A 5 cm width covering blade is also attached behind the furrow openers to cover the furrows opened after seed placement. The intercropping of redgram or castor can also be possible using Anantha planter along with groundnut sowing. The spring type cultivator frame of this planter facilitates to work even in stony soils. The cost of Anantha planter is approx. Rs.55, 000.

V. Inter-cultivation equipment

5.1. Bullock drawn inter-cultivation implement

It is a 4 row bullock drawn inter-culture implement used for removal of shallow depth weeds in between rows of groundnut crop. It consists of 4 straight blades, frame, handle and beam to attach with a pair of bullocks. The blades are fixed to the frame to which handle is attached. The blades are the working components which are made from medium carbon steel or mild steel for more strength to resist soil friction and to have long life. The width of each blade is 15 cm. for operation, the weeder is passed in between the rows of crop so the blades cut and uproot the weeds. Its field capacity is 2.0 ha/day.

Bullock drawn intercultivation equipment

5.2. Tractor drawn inter-cultivation implement

This is a 8 row tractor operated inter-culture implement used for weeding in groundnut crop developed at Agricultural Research Station, ANGRAU, Ananthapure. Its frame is provided with 8 tynes each tyne attached with T or V-shape sweeps to work in between 30 cm row spacing of the crop without any plant damage. Two small width pneumatic tyres of 8.3 X 28 “size need to be fitted to the rear axle of the tractor to run in between rows of the crop instead of normal size tyres to prevent trampling of plants under the tyres. The size of the seeps range from 4” to 6 “. The cost of inter-culture implement and pneumatic tyres with sweeps is approx. Rs.45, 000. Its field capacity is 4 to 5 ha/day.

Tractor drawn inter-cultivation implement

5.3. Boom Sprayer

It is a sprayer with larger width of operation and covers more area in a lesser compared to power sprayers. It consists of a pump, one plastic or fiber glass made tank of 400 litres capacity, control valves, relief valve and a spray boom fitted with nozzles. The pump is operated by the PTO shaft of the tractor at the high pressure of around 20-55 kg/cm^2. The complete sprayer is mounted on 3-point linkage of the tractor. The boom may be of flexible hose pipe on which nozzles are mounted to meet crop row spacing. The bottom is fixed with a rigid beam by clamps. Inlet liquid supply to boom is provided at two points for even distribution of liquid. Hole are provided on the frame to lower or raise the beam to adjust the height of spray. This boom has 13-15 triple action nozzles and can cover 7-8 m width. Two small width pneumatic tyres of 8.3"X28" size need to be fitted to the rear axle of the tractor to run in between rows of the crop instead of normal size tyres to prevent trampling of plants. Its field capacity is 8 ha/day at the operating speed of 3.5 Km/hr. application rate is 400 L/ha and initial cost about 1, 10, 000.

VI. Harvesting equipment

6.1. ANGRAU blade guntaka

ANGRAU blade guntaka designed and developed at Agricultural Research Station, ANGRAU, Anantapur is used for digging of groundnut crop after maturity at the soil moisture range of 8-15%. It is provided with main components frame, 3-point linkage and a straight blade. All the components are made of MS material. The blade is the working component for digging of crop and its length and width are 135 and 8 cm respectively. It has the working width of 135 cm and covers 4-covers 4-5 ha in a day at the recommended speed of operation of 2-3 km/hr. the digging efficiency is 90-95%.

6.2. Groundnut digger, shaker cum windrower

It is also used for harvesting of groundnut crop at soil moisture levels of 8-15% and operated with above 45 H.P tractor. It has the working width of 120 cm and covers 4 rows of groundnut crop at row to row spacing of 30 cm. its overall dimensions are 1700 X 1000 X 1050 mm provided with soil loosening tool of sweep type, a pick conveying mechanism and gatherer windrower. The soil engaging tool is made of high strength mild steel. At the rear, a gatherer windrower the conveying crop. While conveying, soil get removed from crop due to shaking action. The field capacity is

0.8-1.0 ha/h at the recommended speed of operation 2-3 km/h. harvesting and soil separation efficiencies are 96 and 95% respectively. Saving in labor cost and time are 50 and 95% respectively compared to manual harvesting. Its cost is about Rs.1, 80, 000.

VII. Threshing equipment

7.1. Groundnut fresh pod thresher

It is suitable for stripping of groundnut pods from harvested crop and consists of a wire spike type cylinder powered with 2 H.P electric motor. Stripping is done by holding the portion of a bunch manually over spiked cylinder. Three persons can work at a time. It is also provided with a blower and sieve for separation of pods from plant stalk, leaves etc. it saves 40% labour, 50% operating time and 30% cost of operation and it also results in 4% reduction in losses compared to conventional method of stripping. It was developed at ANGRAU, Hyderabad. Output capacity is 120 kg/ha with 100% stripping efficiency and 98% cleaning efficiency.

7.2. Groundnut fresh pod stripper

It is a throw-in type thresher used for separating pods from plants immediately after harvesting of groundnut crop. The farmer no needs to wait for drying of crop after harvesting for threshing. It is operated with PTO shaft (Speed 540 RPM) of 35-45 H.P tractors. It consists of frame, feed hopper, drum type threshing cylinder, concave, oscillating sieves and a blower. Total construction sits on the main frame. The threshing cylinder has the diameter and length of 50 c, and 90 cm respectively and working speed of 320 RPM. The cylinder surface is provided with flat pegs arranged in 6 rows such that each row has 7-8 pegs (length of peg 10 cm). A concave is provided under the threshing cylinder for rough separation of pods and stripped plants. An outlet is provided at the rear portion of cylinder for stripped plants. In order to separate all the unwanted material after threshing from the pod, two sieves have been provided below the concave. The top sieve has holes of 50X17 mm size and the bottom sieve has holes of 25X9 mm size. A centrifugal blower with spiral casing has been provided in between the two cleaning sieves for blowing of light weight plant material coming along with threshed pods from the concave. It has the feed rate of 750 Kg/h and output capacity of 300 kg/h with 96% threshing efficiency. It is very useful where the influence of north east monsoon will be more and continuous rains occur at harvesting time. Initial cost is around Rs. 1, 80, 000. It can easily transported from one place to another place as it is provided with pneumatic tyres.

7.3. Dry pod thresher

This is also a throw-in type thresher for groundnut crop having moisture content of 15-17% crop harvested needs to be dried before threshing. It is operated either with 10 H.P diesel engine or electric motor. It consists of frame, feed hopper, hammer type threshing cylinder, concave, oscillating sieves and a blower. A concave is provided under the threshing cylinder for rough separation of pods and stripped plants. In order to separate all the unwanted material after threshing from the pod, two sieves have been provided below the concave. A centrifugal blower with spiral casing has been provided in between the two cleaning sieves for blowing of light weight plant material coming along with threshed pods from the concave. It has the feed rate of 500 kg/h and output capacity of 200 kg/h with 95% threshing efficiency. Its initial cost is around Rs.1, 10, 000 including 10 H.P diesel engine.

VIII. Decorticating equipment

8.1. Hand operated decorticator

Hand operated groundnut decorticator can be used to shell groundnut pods and to separate kernels. It consists of and oscillating sector with sieve bottom and a handle. Number of hard rubber or cat iron lined assemblies are fitted in the oscillating sector unit. The groundnut pods are shelled between the oscillating sector and the fixed perforated concave screen by rubbing action. The decorticated shells and kernels fall down through the perforated concave sieve. The kernel and shells are collected at the bottom of the unit and separated manually. Clearance between the concave and oscillating sector is adjustable to suit the different varieties and concave sieves are also replaceable depending upon the pod size. Its overall dimensions are 600 X 350 X 700 mm. the capacity and efficiency of the unit are 50 kg/ha and 98% respectively.

8.2. Power operated groundnut decorticator

It is used to shell groundnut pods and to separate kernels. This is operated with 2 H.P single phase electric motor. It consists of feed hopper, rasp bar cylinder with hard rubber linings, perforated concave screen, tow oscillating sieves and a blower. The groundnut pods are shelled between the rubber linings of cylinder and fixed perforated concave screen by rubbing action. The decorticated shells ad kernels fall down on oscillating sieves through the perforated concave screen. A centrifugal blower with spiral casing provided in between the perforated concave screen and oscillating sieves separates the light weight shells from kernels. Oscillating sieves pods from stalk, leaves and other foreign material. Its capacity is 250-300 kg/h and its cost is around Rs.40, 000 along with electric motor.