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Soil Tillage in the Tropics and Subtropics

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Soil Tillage in the

3.0 IMPLEMENTS FOR SECONDARY TILLAGE

Implements for shallow tillage, mulching, working in surface material and weed control.

This group of implements has a very important function in tropical and subtropical climates. The advantages of mulching to prevent erosion and increase the infiltration and water-retention capacity have been mentioned earlier. Good mechanical weed control is also vitally important; on the one hand, measures to increase production (water, nutrients, soil tillage) also encourage weed growth while, on the other hand, mechanical weed control measures reduce the use of chemical herbicides to a minimum with all the resultant ecological and economical advantages.

The types of implements shown in Table 5 are, in principle, available for the functions listed in the heading of this section. The chisel plough and rotary tiller were examined in Chapters 2.3 and 2.4 although they are used mainly for stubble tillage. The plough is also frequently used for stubble tillage and may operate satisfactorily at a depth of only 12 cm. The skim plough, a special implement for stubble tillage, will not be described here because the principles of its design are similar to those of the mouldboard plough. The only difference is that the skim plough is lighter and its bodies smaller. A roller is often mounted behind the skim plough. The investment in a special skim plough is rarely justified since a range of other implements with active, rotating or oscillating tools offers a wide choice for skim and mulch tillage.

implements with passive tools		implements with active tools	
	ground driven	others (pto; hydromotors)	
		rotating	oscillating
skim plough cultivator	disc plough one-way tiller disc harrow rotary harrow rotary hoe	rotary tiller (tine rotor) rotating hoe recipr. rotor	reciprocating hoe

Table 5. Implements for shallow tillage, mulching, incorporation of surface material and weed control.

Mechanical weed control in row crops

The following chapters will discuss equipment which is used between cropping periods.

Weed control is, however, an important tillage operation in an established crop. The weeder (Chapter 4.6) may be used to eradicate small weeds in both broadcast and drilled crops when the crop is still fairly young. In a more mature broadcast crop mechanical weed control will cause too much damage to the crop.

Weeds in row crops can be controlled by special equipment for inter-row cultivation. Basically, these implements consist of a toolbar with weeding units spaced out at intervals equivalent to the distance between the crop rows, similar to the ridgers described in Chapter 4.7 (Figs. 101 and 104). L-, T- and duckfoot-shaped weeding blades can be fitted instead of a ridging body. The working area of these blades travels horizontally and cuts off the roots just below the surface.

Other tools suitable for (parallelogram) mountings are spring tines (see Figs. 70 and 71) and rotary hoe units (Fig. 62).

Large vertical discs or fixed shields may be used to protect the crop from damage by the weeding tools. If they are to operate correctly and efficiently (by cutting as close as possible to the plants) the number of units should be the same as on the sowing machine; the sowing pattern must be followed during the weeding operations.

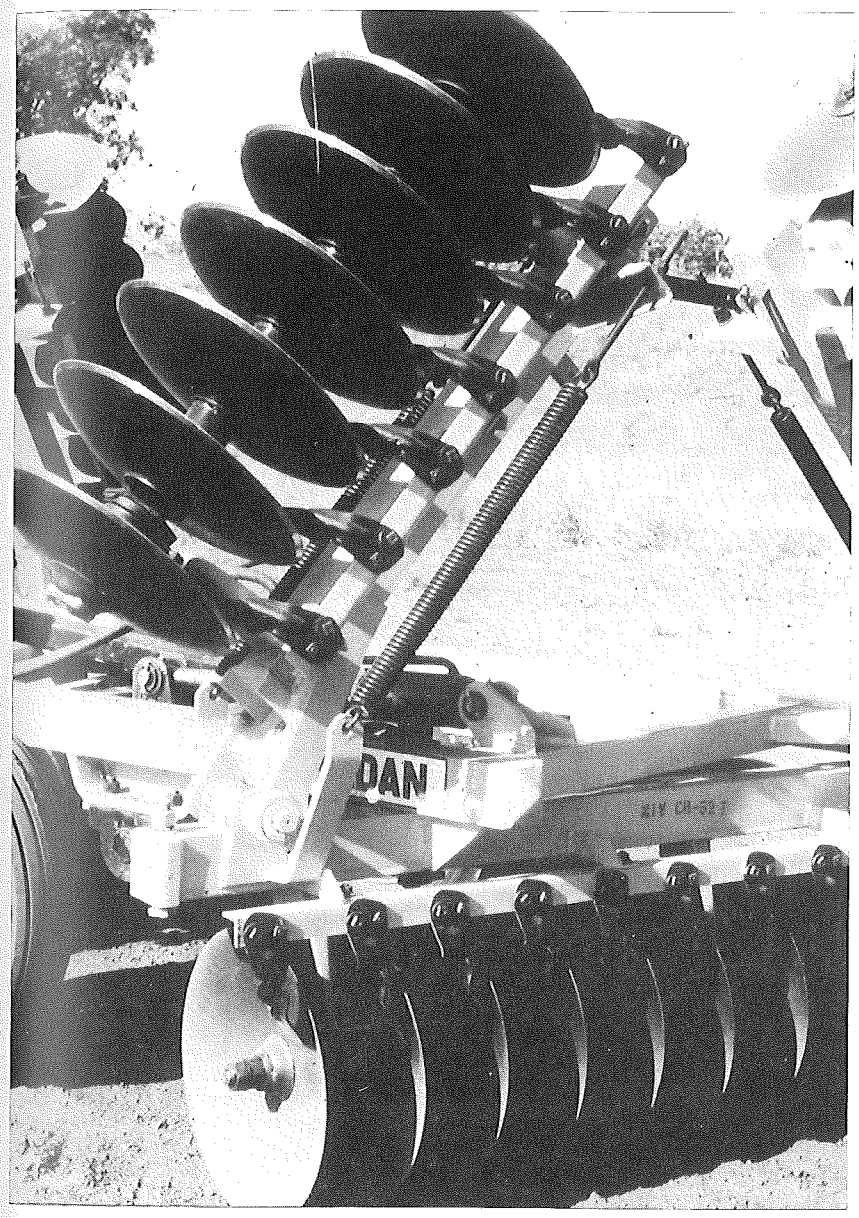
Literature

Bilbro, J.D. and Wanjura, D.F., 1980. Disks versus rotary hoes for increasing cotton emergence. ASAE paper, No. 80-1010, pp. 10.

Bode, L.E., B.J. Butler and L.M. Wax, 1978. Herbicide incorporating capabilities of several tillage tools. 1978 Meeting Weed Science Society of America, 56.

Hartwig, N.L. and L.D. Hoffman, 1980. Incorporation effectiveness of various tillage tools. Proceedings of the Northeastern Weed Science Society, Vol. 34: 82-86.

3.1 The Disc Harrow



3.1.1 Use And Assessment

The disc harrow (Fig. 52) is used for:
- stubble tillage,
- working in long pliable plant residue,
- seedbed preparation for intermediate crops,
- working in manure,
- seedbed preparation in a ploughed field with large clods,
- levelling,
- smoothing out holes after an intermediate crop has been cleared,
- keeping the soil surface open,
- sod cutting before grassland is cleared,
- fallow tillage,
- working in broadcast seeds.

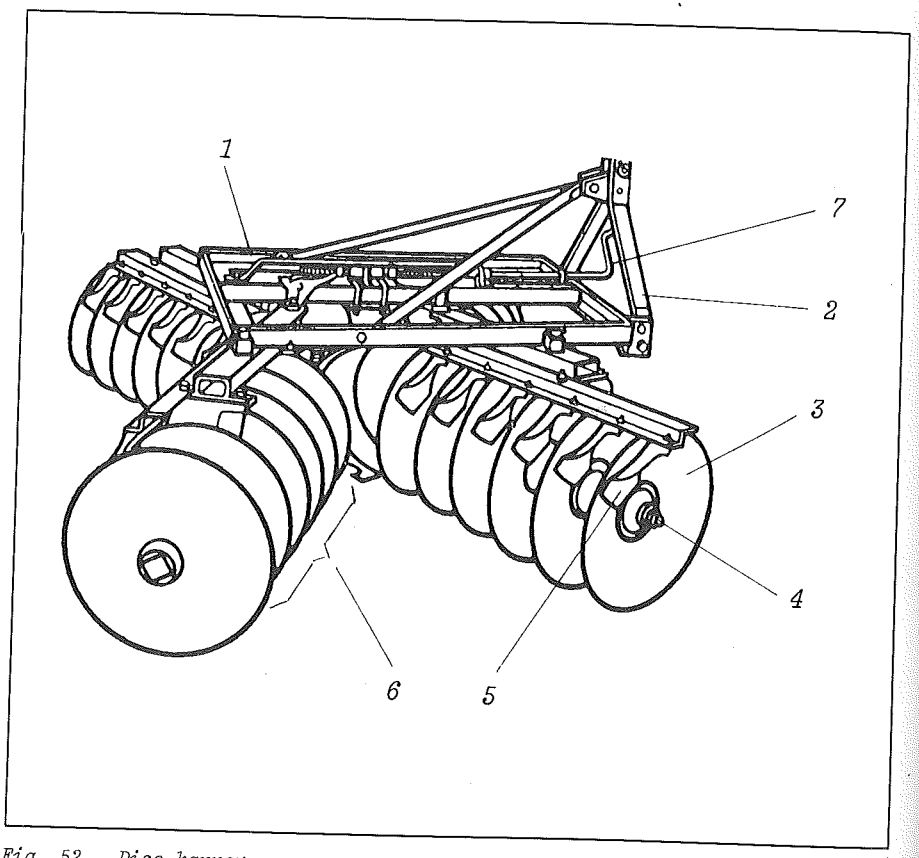


Fig. 52. Disc harrow:
1. Frame,
2. Headstock,
3. Disc,
4. Ball bearing,
5. Scraper,
6. Disc gang,
7. Device for adjusting the disc angle (cutting angle).

Because of its method of operation and range of adjustments the disc harrow can be used for both primary and secondary tillage. This implement is outstanding in its versatility and has the following advantages:
- the ability to work in organic material up to the size of maize stalks,
- reduction of erosion when plant residue can be mulched (in one pass),
- simple to operate, maintain and service,
- highly reliable,
- rolls over obstacles,
- produces hardly compaction soles,
- reduces evaporation by capillary action.

These advantages must be set against the following disadvantages:
- not very effective against root-propagating weeds,
- may cause slaking, crusting and, possibly, erosion in the event of over-intensive tillage,
- usually needs more than one pass (compaction by tractorwheels!),
- high draught requirement,
- hardly any possibility of combining it with other implements.

3.1.2 Functioning

Like all disced implements, the disc harrow does not penetrate the soil of its own accord. Penetration is caused mainly by its own weight and, possibly, extra weights but at certain disc angles it may also be caused by the resistance of the soil.

As in the case of the disc plough, curved discs - set at an angle to the direction of travel - will rotate in the same direction as the tractor-wheels (because of the resistance of the soil). Soil and plant residue are lifted and deposited in a pouring motion. The mixing action is even more thorough as the soil is moved by the next unit (a unit consisting of a group of discs on one shaft is called a "gang"). The discs move the tilled soil layer over the width of one disc to the side facing the disc opening. The rear gang compensates for this movement of the soil by tilling the same strip in the opposite direction. Since, in relation to the front discs, the rear discs are staggered by half the distance between the discs, the ridges thrown up on the surface by the discs and those cut into the bottom of the tilled layer are levelled when working at a speed of 5-6 km/h. The larger the discs, the better they are at rolling over obstacles and coping with plant residue on the surface.

Plain (smooth) discs are generally used. Cut-out discs are preferred when more cutting action (e.g. to cut up surface material or very dry stubble) is required. Their shape gives these discs a very large cutting area. Because of the high impact velocity the corners of the disc edge cause some separation of plant material. Cut-out or notched discs may be used on peat soils since they have less friction and a smaller sticking area and are less likely to become choked. Cut-out discs with less mixing but better cutting action are often used for the front gangs while plain discs whose mixing is better than their cutting action are fitted as the rear gang. The discs' concavity also greatly influences the tillage intensity. A small radius of curvature improves the mixing action but also increases the draught traction required and reduces the lateral forces. The range of adjustments for these discs is limited. If the disc is too wide, the rear of the disc skids and smears the furrow wall.

When the tractor is pulling a trailer implement with the hitchbar sloping forward, the load on the rear gangs is lessened while an extra load is imposed on the front gangs. So extra weights should always be placed behind the centre. The operating speed is 5-6 km/h. The working depth decreases as the speed increases.

In a few cases rollers can be attached at the rear.

3.1.3 Linkage And Drive System

Disc harrows are designed as trailer or mounted implements. They are mounted by the 3-point hitch system (Category I - III) and trailed by a linkage or swinging drawbar.

Since mounted implements have no wheels, they are easy to manoeuvre: the implement is simply lifted for turning and transport.
Trailer implements are usually fitted with transport wheels which can be operated manually or hydraulically. It is not easy to switch the manual type to the transport position and they have to be turned in the field with the discs inserted in the soil.
Heavy disc harrows can be mounted more easily by adjusting the hitchbar hydraulically to the same height as the drawbar.
A special device (Fig. 53) makes it possible to level the implement at any working depth and for the entire weight to be supported almost completely by the discs.

The draught required is between 18 and 25 kW per metre of width depending upon the type of implement, the adjustments and weight. Special types of implements have specific requirements. The effective capacity at 5 km/h is 0.35-0.45 ha/h per metre of width.

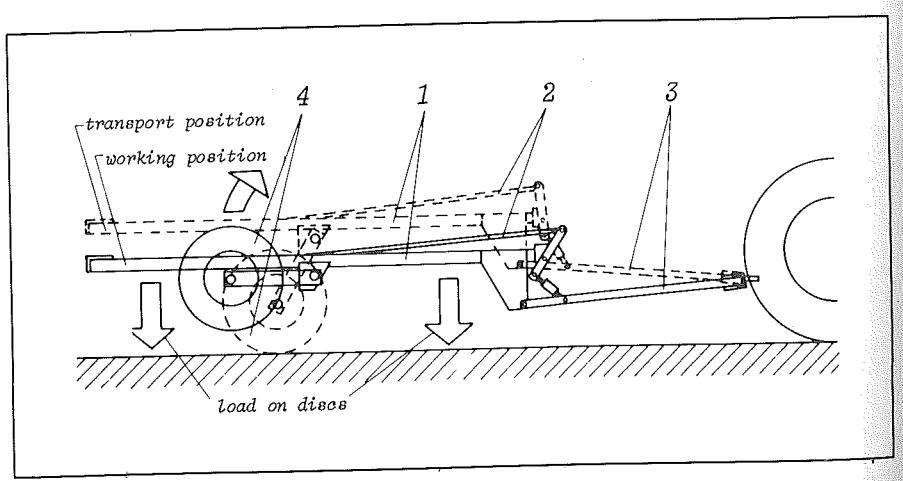


Fig. 53. Hitching device to enable both a full load transfer of the implement mass on to the discs as well as a correct levelling.
1. Frame,
2. Adjusting lever,
3. Drawbar,
4. Support wheels.

3.1.4 Description Of The Implement And Tools

The working parts of the disc harrows (Fig. 54) consist of steel discs. The sharp blades with plain or cut-out edges are 400-650 mm in diameter and 4-6 mm thick. They are usually spherical but sometimes cone-shaped. The concavity (depth at the centre of the disc) ranges from 100 mm for small to 140 mm for large discs. The concave side of the disc faces forward.

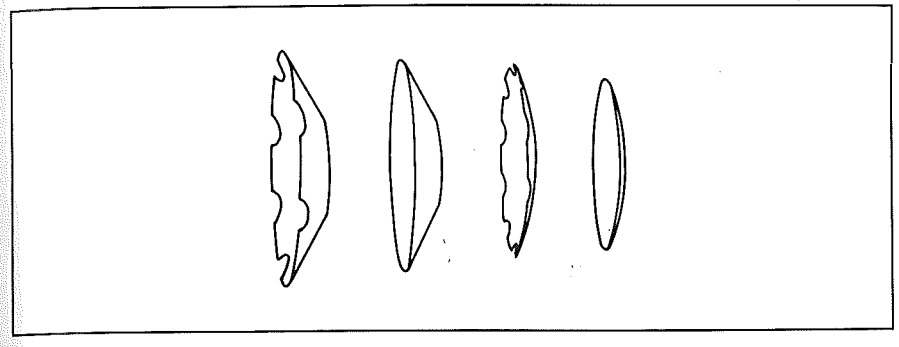


Fig. 54. Disc shapes. From left to right: cone shaped, cut-out; cone shaped, plain; spherical, cut-out; spherical, plain.

Each disc should be fitted with a scraper to remove the soil sticking to it. Discs are mounted in groups on a common shaft at intervals of 100-300 mm. The shaft is mounted on the frame with bearings at an angle to the direction of travel. Two bearings per metre are usually placed on a gang shaft. The types of bearings most commonly used at present are the ball- or tapered roller bearings with special dirt seals. Hard wood and white iron bearings are fitted on older or cheaper models.
Gangs are placed in adjoining or following pairs at adjustable angles so that the discs cut into the soil when the implement is moved forward. The lateral forces exerted on one gang by the soil are counter-balanced by those acting on the matching unit with its opposite curvature and direction of work. On larger trailer implements the remote hydraulic system which operates the transport wheels also acts as a depth control system.

Various methods are used to attach the gangs to the frame (Fig. 55).
The following general types of disc harrow can be distinguished:
Single acting: Two gangs are placed end to end so that they form an obtuse angle to the direction of travel (Fig. 55.1);
Double acting or tandem: Four gangs are arranged in the shape of an X (Fig. 55.2).
V (or A)- shaped: Two gangs are arranged behind each other (along the direction of travel) and form an open V (A) to one side (Fig. 55.3);
Offset: Here again two gangs are arranged behind each other but are staggered laterally. This makes it possible to work in an offset position so that the harrow moves to the left or right of the tractor (very suitable for orchards) (Fig. 55.4).

The V shaped and offset types are basically identical and in most cases the offset position can be fixed by adjusting the hitch.

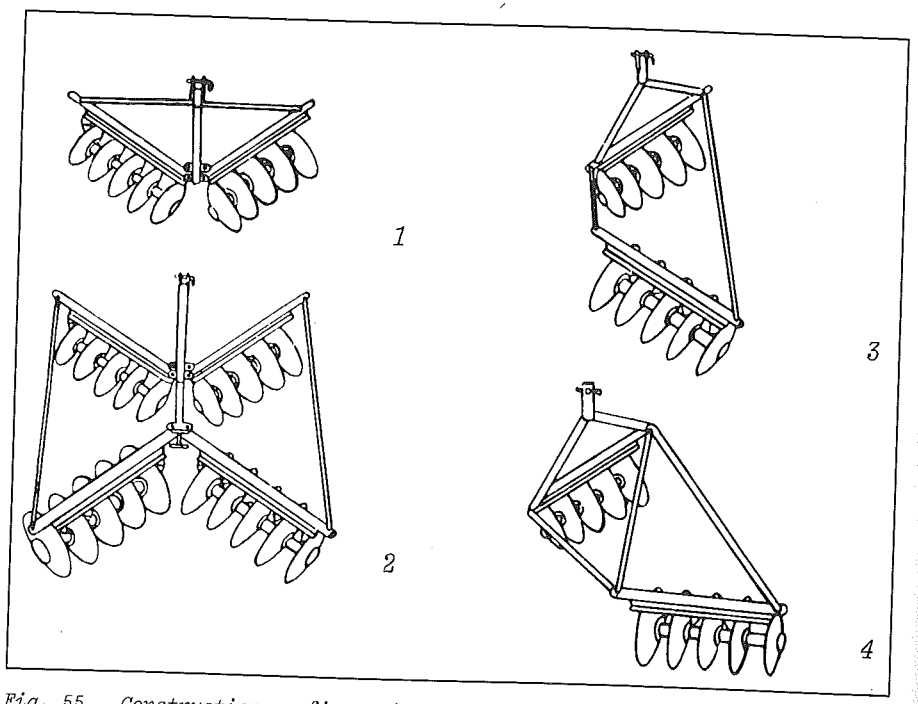


Fig. 55. Construction configurations of disc harrows:
1. Single acting,
2. Double acting or tandem,
3. V (A) shaped,
4. Offset.

Disc harrows are available for any type and size of tractor. Very large implements have a hinged folding frame, allowing the various units to follow the contours of the field (Fig. 56). Staggered disc gangs are preferred nowadays because they do not leave a strip of untilled soil in the centre (Fig. 57).

"Heavy-duty" disc harrows are manufactured for special conditions. With a disc diameter of 900 mm and a working width of 2.50 m, a 16-disc implement (weighing 5 tonnes) requires a draught of 150 kW. These types can be used for clearing scrub or on sugar-cane plantations. These heavy disc harrows are also equipped with hydraulically raised transport (depth) wheels.

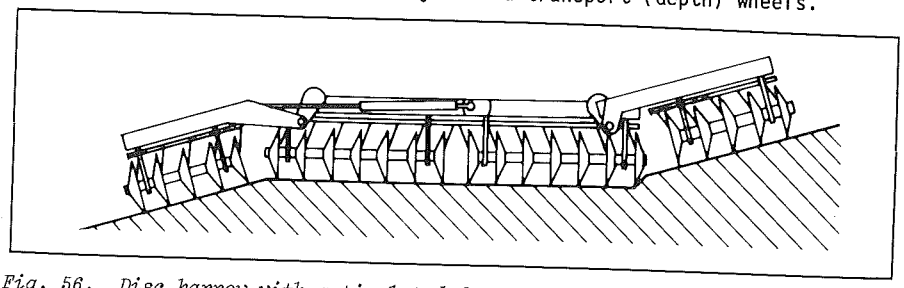


Fig. 56. Disc harrow with articulated frame for undulating surfaces.

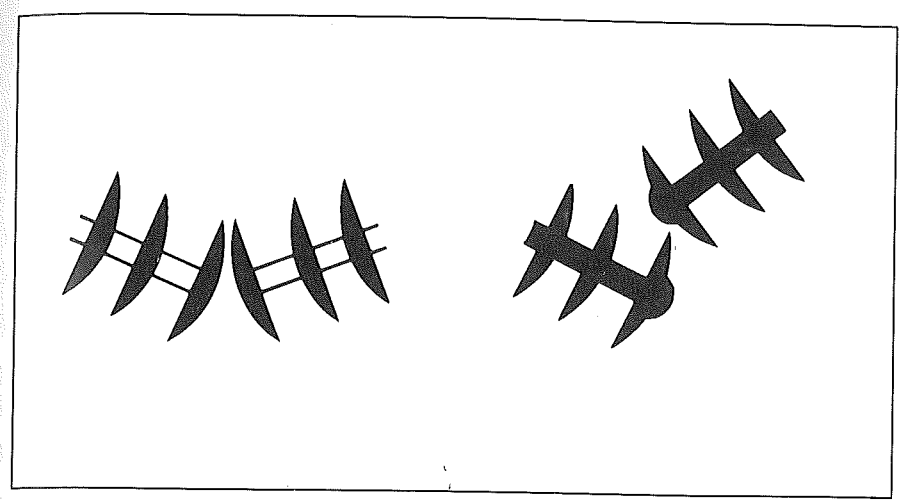


Fig. 57. Arrangement of the front disc gangs.
Left: overlapping action of center discs, right: center strip left untilled.

3.1.5 Adjustment, Operation

The external factors which influence the quality of the tillage are: the soil type and condition, soil moisture content, organic matter content, stones, roots and plant residue on the surface.
A number of fixed and adjustable parameters of the implement determine the working depth and intensity. These parameters are:
- the diameter of the discs,
- shape of the discs' circumference (plain or cut-out edge),
- weight per disc,
- curvature and shape of the disc,
- sharpness of the cutting edge,
- the units' angle to the direction of travel (disc or gang angle),
- travel speed.

The discs are fitted vertically on every disc harrow; only the disc angle can be adjusted either for each gang or for each set of related gangs. These angles can be adjusted mechanically or hydraulically to between 14 and 23 degrees to the direction of travel. So the discs' cutting plane forms an acute angle to the direction of travel (Fig. 58).

Since the adjusting devices are coupled, paired units will always be adjusted symmetrically. A small angle gives a better cutting action and greater working depth (though seldom more than 15 cm) while a wide angle produces better crumbling. The disc angle cannot be adjusted on some implements and the depth is fixed hydraulically by the transport and depth wheels. Each disc places a weight of 25-50 kg on the soil and this may be increased by extra weights (100 kg/disc) or reduced by using a transport wheel system. The cutting edges are self-sharpening so that the discs need only occasional grinding. The implement is easily operated by one man.

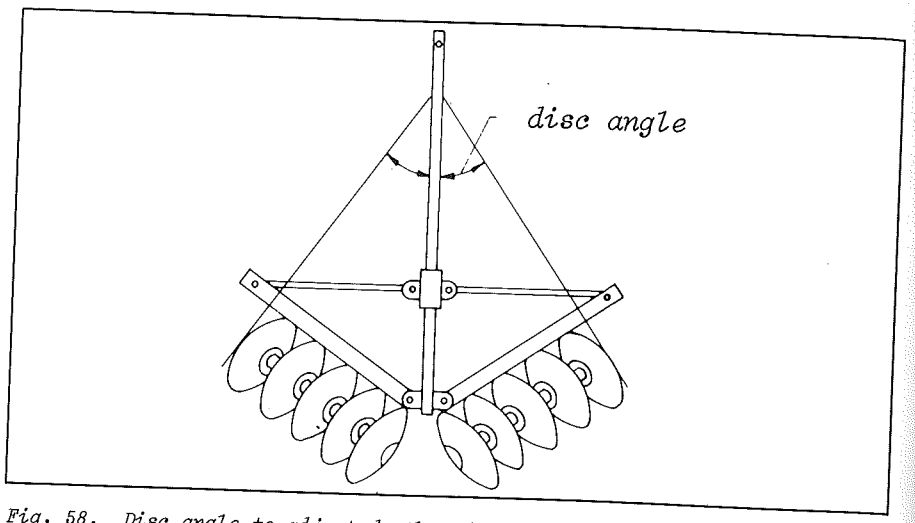


Fig. 58. Disc angle to adjust depth and intensity of tillage.

3.1.6 Technical Data

Length	2.00 - 8.00 m
Width	1.00 - 10.00 m
Height	1.00 - 1.50 m
	folding types 3.00 m
Number of gangs	2 - 12
Discs	plain or cut-out
Number of discs	single acting 4 - 6 per m
	double acting 8 - 12 per m
Distance between discs	160 - 300 mm
Diameter of discs	400 - 650 mm (900 mm)
Concavity (depth)	100 - 200 mm (300 mm)
Thickness	4 - 6 mm (9 mm)
Disc angle	14 - 23 degr. with direction of travel
Weight	25 - 50 kg per disc
Power requirement	1.0 - 2.5 kW per disc

3.1.7 Literature

See literature of chapter 3.0.

Gill, W.R., A.C. Bailey and C.A. Reaves, 1982. Harrow disk curvature - influence on soil penetration. Transactions of the ASAE, 25(5): 1173-1180.

Gill, W.R., C.A. Reaves and A.C. Bailey, 1981. The influence of harrow disk curvature on forces. Transactions of the ASAE, 24(3): 579-583.

Sheikh, G.S., J. Sial and M. Afzal, 1980. Disk harrow - an appropriate tillage implement. AMA, 11(4): 41-44.

3.2 The Rotary Harrow

3.2.1 Use And Assessment

The rotary harrow can be used on light, heavy and stony soils and on both level land and slopes.
The implement is used for:
- stubble tillage,
- working in chopped short material,
- seedbed preparation for intermediate crops,
- working in manure,
- cutting grass sods,
- weed control (fallow tillage),
- seedbed preparation after ploughing (possibly used as a rear-mounted implement),
- aerating the soil and breaking up crusts,
- reducing evaporation losses.

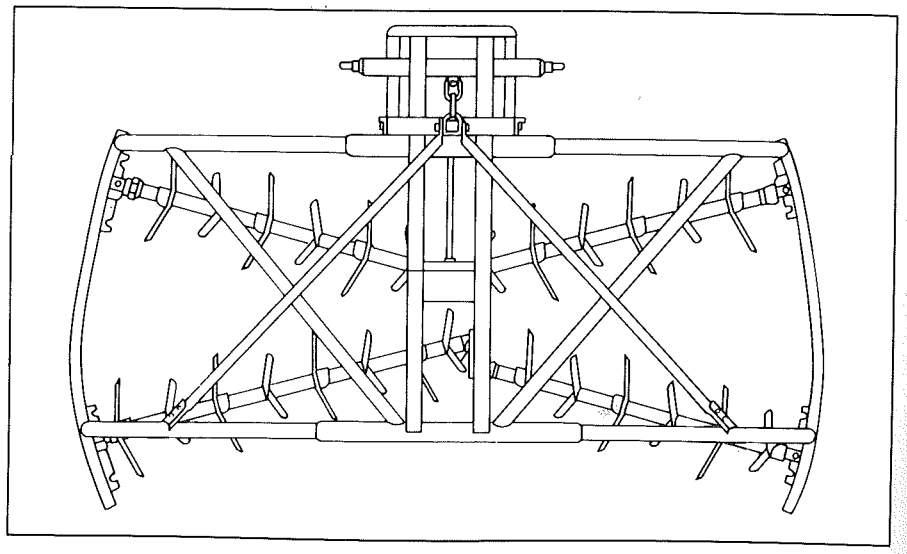


Fig. 59. Rotary harrow.

The rotary harrow is a simple implement (Fig. 59).

Its main advantages are:
- good mulching action on light to medium heavy soils,
- no smearing, but a tearing effect,
- increases the infiltration capacity,
- reduces evaporation by capillary action,
- reduces the risk of soil erosion because it produces a coarse surface mixed with plant residue,
- wide range of uses obtained by changing the setting, weight and speed,
- high working speed and capacity,
- versatility,
- possibilities for extra attachments or combinations with other implements,
- simple maintenance and servicing,
- good manoeuvrability and reliability,
- low price.

The following disadvantages should be mentioned:
- inability to work in long plant material satisfactorily,
- risk for wrapping, especially of moist straw on light soils,
- high working speed (8-12 km/h) required, i.e. more demands on the tractor and driver,
- two or more passes (crosswise) required,
- less effective on hard soils.

3.2.2 Functioning

The soil's resistance drives the active tools of the rotary harrow. The knives inserted in the soil are held by it and the implement's forward movement causes the shaft to rotate so that other knives cut into the soil. Since the cutting angle of the knives changes, the soil is not cut - as with the rotary tiller - but is torn away by a "rolling-off" movement. The soil is transported sideways by the front gang and returned by the rear gang and is crumbled and mixed in the process; the intensity of the latter operations depends upon the forward speed. The lateral forces occasioned by the tearing action are offset by the arrangement of the gangs in the frame.

When the harrow has flexible hitching it travels with a "wriggling" movement and may therefore be used for preparing a seedbed on ploughed soil. The soil must be thoroughly broken up (8-12 cm deep) when seedbeds are prepared on stubble. Stubble, straw and weeds are worked in at shallow depths so that rotting is accelerated. Volunteer grain and weed seeds may emerge. Two or more passes are required before an effect comparable with the rotating hoe can be achieved. The drier and harder the soil, the less the effect even if sharpened knives are used with multiple (crosswise) passes.
Long moist plant residue may easily cause wrapping and choking.
The required tillage can be achieved only at high speeds. The rotary harrow is often combined with a crumbling roller, especially for seedbed preparation. It is also used as a rear-mounted attachment for the chisel plough.

3.2.3 Linkage And Drive System

The rotary harrow is usually mounted with the 3-point hitch system (at least for transport). Wide harrows (more than 3 m) can be folded hydraulically while extended harrows can be carried (lengthwise) on a trailer.
When in a working position rotary harrows may be fixed in the 3-point hitch or allowed freedom of movement in relation to the tractor. A crossbar whose height and width can be adjusted is used for mounting on the lower links; the upper link is often a chain or the entire rotary harrow may be suspended from one heavy chain.

Rotary harrows follow the contours of the soil and do not have to be lifted for turns because of the flexible mounting of the hitch and the blade gangs which can move vertically. The capacity is about 1 ha/h per metre of working width at a speed of 12 km/h. The draught required depends upon:
- the working width,
- the number of blades,
- the weight,
- the soil type and condition.

Some information on the power required is given in Table 6:

blade gang arrangement	working width (m)	power requirement (kW)	mass without extra weights (kg)
2 rows	1.70	as from 25	300
3 "	1.70	" 32	400
2 "	2.00	" 35	350
3 "	2.00	" 42	450
2 "	2.50	" 45	450
3 "	2.50	" 55	650
2 "	3.00	" 55	700
3 "	3.00	" 65	1000

Up to 50% of the mass of the implement can be added by extra weights.

Table 6. Power requirement of rotary harrows.

3.2.4 Description Of The Implement And Tools

Two to six or sometimes even eight tool-bearing shafts (gangs) are mounted in a steel frame with adjustable slide bearings (Fig. 59). Two gangs fitted perpendicularly (angled) to the direction of travel form one row. Any two successive rows form a X or diamond shape. Other types have only one gang over the entire working width. Implements with two rows (one right and one left-handed) leave a very level surface. The gangs have some upwards and downwards movement so that they can more easily follow the surface of the soil.

Working sets of blades, curved to one side (Fig. 61), are mounted on the shaft at intervals of about 20 cm and are separated by spacers. A working set consists of two blades mounted perpendicularly to each other and 10 mm thick, slanted and easily replaceable. Each working set is staggered at 45 degrees to the next set. The mulching effect is produced specifically by the slanting blades. The working sets on successive gangs face right and left alternately. Straw rejectors on the shaft bearings prevent wrapping.

Most implements allow weight boxes to be attached or have facilities for "pick-a-back" shaped weights. The link between the hitch frame (column) and frame is flexible to some extent so that the implement can follow the contours of the soil.

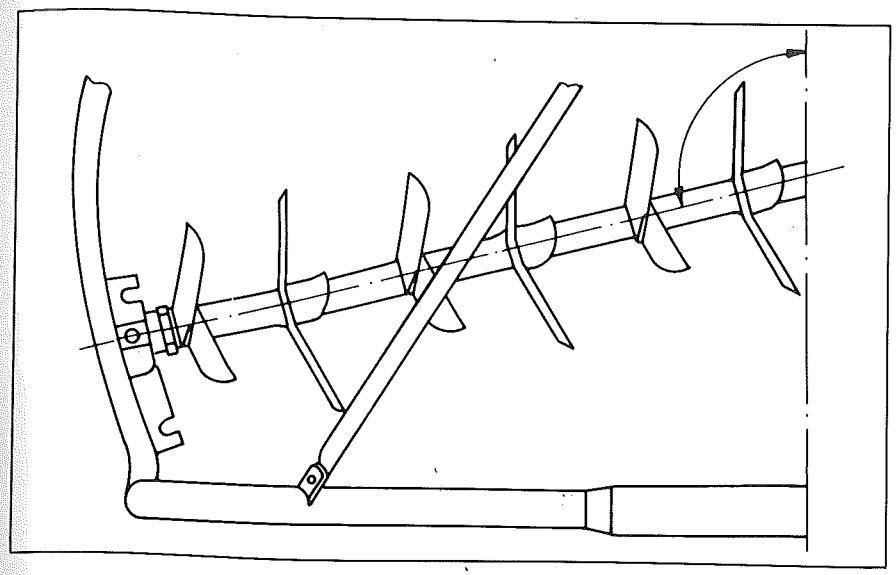


Fig. 60. Adjusting the blade angle (the rear, left-hand gang is shown).

3.2.5 Adjustments, Operation

On many makes the blades can be set along the direction of travel (cutting action) or across it (churning and crumbling action), as required. The angle between the gangs and the direction of travel (blade angle or grip) can be adjusted by shifting the mountings on the frame (Fig. 60, Table 7).

A narrow blade angle should be used to avoid wrapping on moist soils and with large amounts of straw.

	blade angle (in degrees)		
	strong	medium	slight
front gang	70	75	80
center gang	110	105	100
rear gang	70	75	80

Table 7. Blade grip of rotary harrows.

The working depth can be increased by extra weight. Careful adjustment of the upper link with a fixed mounting is needed to obtain the same depth for the front and rear gangs. The intensity and quality of the tillage is strongly influenced by the travel speed which should be between 8 and 15 km/h.

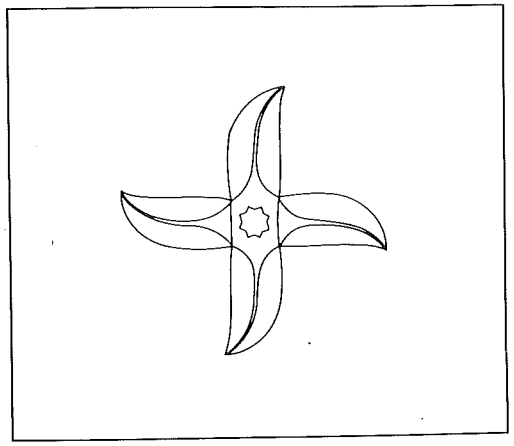


Fig. 61. Working set of a rotary harrow.

3.2.6 Technical Data

Length	1.50 - 3.50 m
Total width	1.60 - 5.50 m
Height	1.00 - 1.30 m
Working width	1.50 - 5.00 m
Number of gangs	2 - 8
Number of blades per metre of working width	2 row implement: approx. 10 3 row implement: approx. 15
Spacing of working sets	150 - 200 mm
External diameter	370 - 400 mm
Length of blades	370 - 400 mm
Width of blades	about 70 mm
Thickness of blades	about 10 mm
Weight per metre of working width	150 - 250 kg (without extra weights)
Weight per working set	20 - 25 kg (with extra weights)
Power requirement	15-25 kW per m

3.2.7 Literature

See literature of chapter 3.0.

Zumbach, W., 1975. Erfahrungen mit Spatenrolleggen. FAT Mitteilungen, Schweizer Landtechnik 37(8): 490-496.

3.3 The Rotary Hoe

3.3.1 Use And Assessment

The rotary hoe (USA: skew treader, Fig. 62) is used for:
- weed control in row crops,
- soil preparation in irrigation practices,
- breaking up crusts, loosening and aeration (also over germinating seeds),
- working in broadcast seeds, manure or fertilizers and chemicals,
- crumbling and packing of seedbeds,
- ridging for plant rows and also for forming ridges before planting,
- flattening stubble and other plant residue so that they can be worked in more satisfactorily.

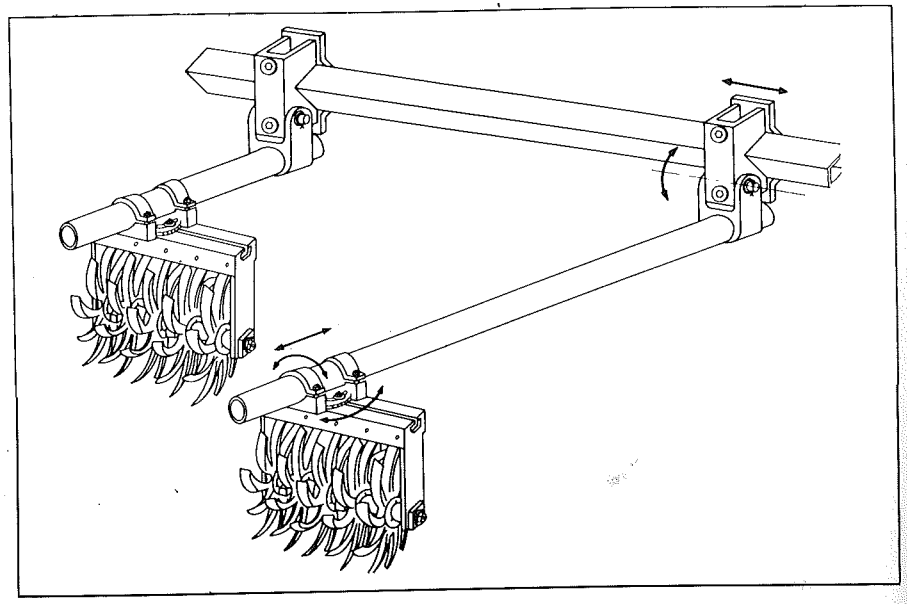


Fig. 62. Rotary hoe.

The rotary hoe is simple in design and reliable to use. So it is very suitable for developing countries. The supporting frame can also be used to attach a large number of other tools, especially ridging bodies.

The advantages which should be mentioned are:
- high capacity owing to the high speed (up to 14 km/h),
- low draught requirement,
- easy to use and maintain,
- easy to adapt to other conditions or to increase its width,
- can be combined with other implements,
- good manoeuvrability,
- can be used with a wide range of soil moisture provided that the soil can take traffic; also works well on dry soils.

The main disadvantage is the possibility that a compacted layer may be formed at a shallow depth. Moreover, this implement is not particularly effective with larger weeds and there is a serious risk of choking.

3.3.2 Functioning

Essentially the rotary hoe can be used for two different purposes:

A. The curved tines point forward when penetrating the soil. The tines' sharp tips meet the soil vertically and penetrate for 25-50 mm depending upon the weight and condition of the soil. The tools are rotated by the soil's resistance. When the tines emerge from the soil, it is thrown upwards. With this type of operation parts of the soil crust are loosened and the roots of weeds are destroyed or left exposed on the surface and dry out. The best results are obtained either before the emergence of the crop or when the plants are tall enough to withstand the treatment without serious damage.

B. When shallow tillage is required, the implement is drawn backwards so that the tines point backwards and do not penetrate deeply into the soil. With this method the rotary hoe can compact a seedbed, work in broadcast seeds or tread a layer of surface material into the soil. Plant residue may be spread evenly over the surface without choking.

With both types of use the best work is achieved at speeds of between 8 and 17 km/h. The crumbling action cuts off the capillary movement of water in the soil and thus reduces evaporation losses. Rotary hoes may be designed for use at full width and for strip tillage. The angle of the working sets can be adjusted both horizontally and vertically so that the rotary hoe can be used for ridging (or destroying ridges) and for increasing the intensity of the tillage. It can be guided in the direction of travel by using disc coulters (approx. 500 mm in diameter). The crop can be protected by special screens or discs. The width of the implement can easily be extended by adding more units. The hoe is also used as a rear-mounted tool behind chisel or sweep ploughs.

3.3.3 Linkage And Drive System

The rotary hoe is either mounted to the 3-point hitch system and used in free-floating mode or simply employed as a trailer implement. The tine sets are driven by the soil. The draught requirement is low (5-8 kW/m) but may rise to 10 kW/m at higher speeds. Very wide implements can be folded for transport.

3.3.4 Description Of The Implement And Tools

Rotary hoes can be built in various designs:

The first type, the rotary hoe, has working sets of 12 to 18 radial, slightly curved tines made of spring steel. These sets ("spider" wheels) with diameters of 400-500 mm, are assembled in gangs perpendicularly to the direction of travel. The gangs are often fitted with roller or ball bearings to auxiliary frame sections mounted flexibly on the main frame (Fig. 63). With this system all the tools can follow uneven surfaces.

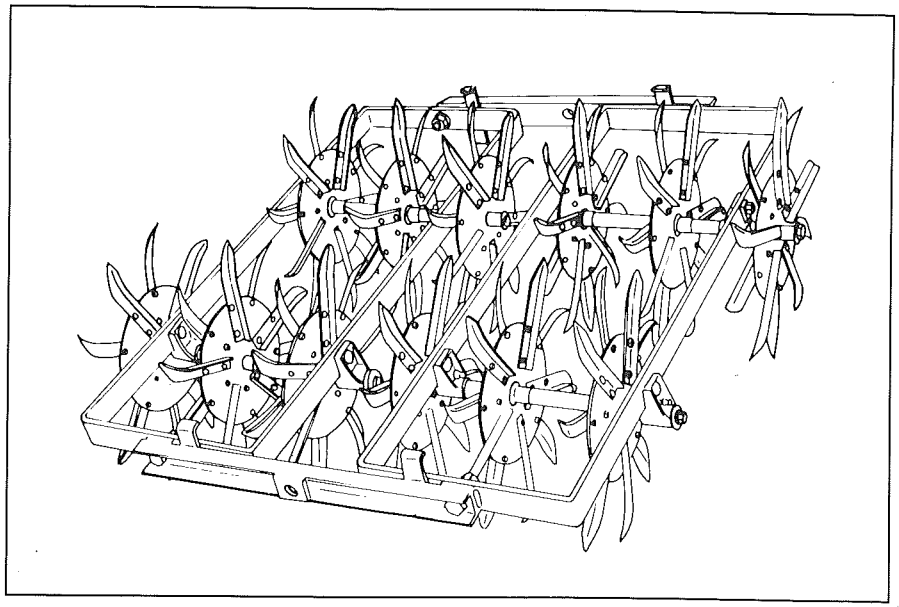


Fig. 63. Auxilliary frame sections of a rotary hoe equipped with spider wheel gangs.

A second type (similar to the Lilliston principle and usually called rotary cultivators) uses cast iron wheels or working sets (Fig. 64). Three to seven of these sets are again arranged in gangs and mounted on a light steel frame (tool carrier). These frames can be moved along the direction of travel and rotated horizontally and vertically because they are mounted on a shank positioned along the direction of travel (see Fig. 62). These shanks are attached - either rigidly or with hinges (hinged singly or in a parallelogram) - to the main toolbar so that they can be shifted laterally to adjust to the distance between the rows. Consequently, the individual gangs each adjust to the uneven surface of the field.

3.3.5 Adjustments, Operation

The depth is determined by the weight of the implement or it can be adjusted by adding extra weights; the weight may be offset by the tractor's hydraulic system or the support wheels. On some types the gangs are spring-loaded. The implement is drawn forwards or backwards, increasing and reducing the penetration in keeping with the required type of tillage. The individual sections can be adjusted horizontally and vertically for ridging in row crops or for shallow tillage of ridges and contours. As on the disc and rotary harrow, the gangs are set at an angle to the direction of travel (grip) so that the soil moves in the direction of travel and the rotation. New ridges may be formed or existing ones moved by means of this setting. A screen can be used to protect small plants from damage or from being buried by the soil.

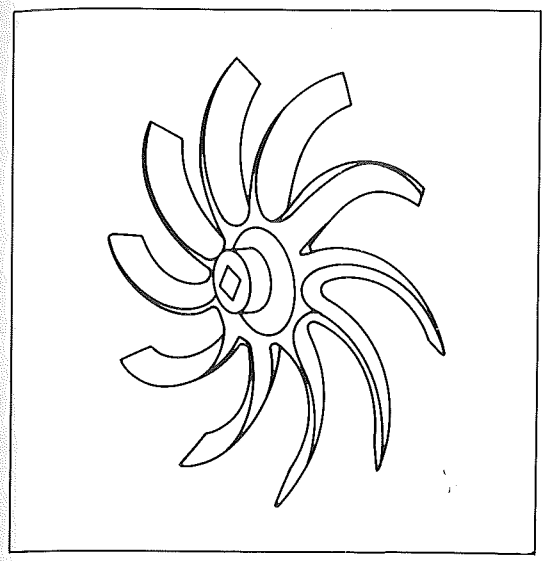


Fig. 64. Spider wheel (cast iron).

3.3.6 Technical Data

Width		1.00 - 8.00 m
Height		.60 - 1.20 m
Length		1.20 - 1.80 m
Working sets	no. per metre of shaft:	4 to 5
	spacing on the shaft:	60 - 150 mm
	diameter:	450 - 550 mm
	tines per set:	12 - 18
Weight		150 - 200 kg per metre of working width
Power required		5-10 kW/m

3.3.7 Literature

See literature of chapter 3.0.