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3.1 When using irrigation furrow 3.2 Furrow Layout 3.3 Furrow Construction 3.4 Irrigated Furrow 3.5 Planting Methods 3.6 Serving furrow furrows are small, parallel channels made to transport water for irrigation. The crop is usually grown on ridges between furrows (figures 23 and 24). Figure 23 Furrow Irrigation3.1 When using irrigation furrows 3.1.1 Suitable crops 3.1.2 Suitable slopes 3.1.3 Suitable Furrow irrigation soils suitable for a wide range of soils, crops and earth slopes as indicated below. The question of under what circumstances to choose furrow irrigation is then discussed in Chapter 7. 3.1.1 Suitable furrow irrigation culture is suitable for many cultures, especially a number of cultures. The crop, which will be damaged if the water has covered their stem or crown, should be irrigated furrows. Figure 24 View from above and cross-section of furrows and ridges of irrigation furrow is also suitable for growing tree crops. In the early stages of tree planting, a single furrow next to a tree line may be enough, but as the trees develop, two or more furrows can be built to provide enough water. Sometimes a special zigzag system is used to improve the spread of water (Figure 25). The irrigation of corrugation, often mentioned in literature, is a special type of furrow irrigation used to broadcast crops. Corrosion is a small hill pushed to the surface of the soil. The use of this method is limited and is not included in the current guide. Thus, the following crops can be irrigated by irrigating furrows: - a number of crops such as corn, sunflower, sugar cane, soybeans; Crops that will be damaged by flooding, such as tomatoes, vegetables, potatoes, beans; Fruit trees such as citrus fruits, grapes; - the transmission of crops (the method of ophration) such as wheat. Figure 25 zig-zag furrows - A: zig-zag furrows used to irrigate trees on land with moderate slope (0.5-1.5%) Figure 25 zig-zag furrows - B: Another zigzag pattern for irrigating furrows on fairly flat slopes (up to 0.5%) 3,1,2 Suitable slopes Single flat or gentle slopes are preferable to irrigation furrow. They should not exceed 0.5%. Usually a gentle slope of the furrow is provided up to 0.05% to help drainage after irrigation or excessive rainfall with high intensity. On the undulating earthen furrows should follow the contours of the earth (see figure 26). However, this can be a difficult operation that requires very careful circuits before cutting the furrow (see section 3.3 Furrow Construction). Figure 26 Contour furrow3.1.3 Suitable soil furrows can be used on most soil types. However, as with all surface irrigation methods, very rough sands do not because the loss of seeping can be high. Soils that are easy to bark are especially suitable for irrigation furrows because water does not flow along the ridge, and so the soil in which the plants grow remains loose.3.2 loose.3.2 Layout 3.2.1 Length Furrow 3.2.2 Shape Furrow 3.2.3 Furrow Distance This section is dedicated to the shape, length and interval of furrows. Typically, shape, length and distance are determined by natural conditions, i.e. tilt, soil type and affordable flow size. However, other factors, such as the depth of irrigation, agricultural practice and the length of the field, may also influence the structure of the furrow. 3.2.1 Furrowle-length furrows should be combined with slope, soil type, flow size, irrigation depth, growing practice and field length. The effect of these factors on the length of the furrow is discussed below. Slope Although the furrows can be longer when the slope of the ground is steeper, the maximum recommended slope of the furrow is 0.5% to avoid soil erosion. The furrows can also be smooth and thus very similar to long narrow pools. However, a minimum grade of 0.05% is recommended so that effective drainage can occur after irrigation or excessive rainfall. If the slope of the earth is steeper than 0.5%, the furrows can be set at an angle to the main slope or even along the contour to keep the slopes of the furrow within the recommended limits. The furrows can be installed in such a way when the main slope of the ground does not exceed 3%. In addition, there is a great risk of soil erosion after breaking into the furrow system. Terraces (see pool irrigation) and furrows along terraces can also be built on steep grounds. Soil type In sandy soils water penetrates quickly. The furrows should be short (less than 110 a), so that the water reaches a downward end without excessive leakage losses. In clay soils the penetration rate is much lower than in sandy soils. The furrows can be much longer on clay than on sandy soils. The speed of penetration is explained in Annex 2. The flow size Is usually a flow size of up to 0.5 l/s will provide adequate irrigation, provided that the furrows are not too long. When large flow sizes are available, water will move quickly down the furrows and therefore, usually, the furrows can be longer. The maximum flow size that will not cause erosion will obviously depend on the slope of the furrow; in any case, it is recommended not to use flow sizes over 3.0 l/s (see table 3). The depth of irrigation Application of large irrigation depths usually means that the furrows can be longer because there is more time for the water to flow down the furrows and penetrate. The practice of growing When agriculture is mechanized, furrows should be made as long as possible to facilitate the work. Short furrows require a lot of attention as the flow has to be changed frequently from one furrow to another. However, short furrows can usually be irrigated more effectively than long ones as it is much easier to keep the loss of seeping low. Field Length May Be Practical to make the length of the furrow equal to the length of the field rather than the perfect ideal when this will lead to a small piece of land left (Figure 27). Equally, the length of the field can be much smaller than the maximum length of the furrow. Usually this is not a problem, and the length of the furrow is made in the bridle of the boundaries of the field. Figure 27 Field Length and Furrow Length Table 3 gives some practical values of maximum furrow length in shallow irrigation conditions. The values shown in Table 3 are below the values usually listed in the irrigation guides. These higher values fit in larger, fully mechanized conditions. Table 3 PRACTICAL Values FROM MAXIMUM FURROW LENGTHS (m) IN FREE SLOPE, SOIL TYPE, STREAM SIE AND NET EAST DEPTH Furrow Slope (%) Maximum flow size (l/s) per Furrow Clay Loam Sand Net Irrigation Depth (mm) 50 75 50 75 50 75 0.0 3.0 100 150 60 90 30 45 0.1 3.0 120 170 90 125 45 60 0.2 0.2 120 90 125 45 60 0.2 0.2 5 130 180 110 150 60 95 0.3 2.0 150 200 130 170 75 110 0.5 1.2 150 200 130 170 75 110 Important: This table contains only approximate information concerning tilt, soil type flow size and water depth to the length of the furrow. This should only be used as a guide, since the data are based mainly on field experience rather than on any scientific relationship. For sufficient effective irrigation, the maximum values of furrow length are given. However, the length of the furrow may be even shorter than those given in the table, and in general it will help improve the effectiveness of irrigation. Only by installing a furrow system, following the guidelines and then assessing its performance, can the appropriate system be diluted for a given area.3.2.2 The shape of the furrow shape of the furrow depends on the type of soil and the size of the flow. Soil type In sandy soils, water moves faster vertically than sideways (I'm lateral). Narrow, deep V-shaped furrows are desirable to reduce the area of soil through which water seeps (Figure 28). However, sandy soils are less stable and tend to collapse, which can reduce irrigation efficiency. In clay soils, there is a much more lateral movement of water and the penetration rate is much less than for sandy soils. Thus, a wide, shallow furrow is advisable to get a large wet area (Figure 29) to encourage penetration. Figure 28 Deep, narrow furrow on sandy soil Figure 29 Broad, shallow furrow on clay soil Stream size Overall, the larger the flow size, the larger the furrow should contain a flow.3.2.3 Distance furrow distance depends on the type of soil and the practice of furrowing. The type of soil, usually for sandy soils, should range from 30 to 60 cm, i.e. 30 cm for coarse sand and 60 cm for fine sand. On clay soils, the distance between two adjacent furrows should be 75-150 cm. On clay soils, two-used fields can also be used which are sometimes called beds. Their advantage is that there are probably more rows of plants on each ridge, which makes it easier The ridge can be slightly rounded at the top to drain the water, which would otherwise tend to be a pond on the surface of the ridge during heavy rainfall (Figure 30). Figure 30 Double Furrow Cultivation Practice In Mechanized Agriculture compromise is needed between the mechanism available for cutting furrows and the ideal interval for crops. Mechanical equipment will lead to less work if the standard width between furrows is maintained, even if the crops grown usually require different planting distances. Thus, the distance between tool attachments does not need to be changed when moving equipment from one crop to another. However, care is necessary to ensure that standard intervals provide adequate lateral wetting on all types of soil.3 Building a furrow is the most common way to build a furrow with a crest. Figure 31 shows animals and hand-drawn Ridgers. Figure 31 Ridger Plough: a) Wooden Case, Animal Painted Figure 31 Ridger Plough: (b) Type of Iron, Animal Painted Figure 31 Ridger Plough: (c) Hand-drawn version of CONSTRUCTION OF FURROWS ON FLAT OR MILDLY SLOPING LAND The next steps are taken to build a furrow: installation; Formation of one (or more) ridge (s); forming one (or more) parallel ridge (s). Step 1 Direct Line is set in a field along the proposed furrow line. This can be done by creating a range of poles or marking lines on the ground with chalk powder or small mounds of earth. An experienced ploughman should be able to plow along the line by aligning poles or earth mounds on the eye (Figure 32). Figure 32 Markers are put along the straight line Step 2 ridge moves along the line. The resulting furrow should be straight. If not, the area should be plowed again and the procedure repeated. Step 3 About every five (5) meters, a new straight line should be installed. If you use a comb-drawn bar associated with a tractor, you can draw four furrows at the same time. On the track back the left ranger is put in the last furrow of the track to make sure that the new grooves of the arc parallel to the previous one (Figure 33). You should also check that there are straight lines: a center line is set for each track (see figure 33). Warning: It should always be kept in mind that a new straight line must be installed before a new furrow track is made. Figure 33 Ridge-drawing behind a tractor makes four ridges simultaneously CONSTRUCTION OF FURROWS ON SLOPING OR UNDULATING LAND Special assistance is needed for the construction of furrows along the contour on sloping or undulating ground. The following steps are taken to build a furrow along the contour: Step 1 guide furrow must first be installed along the upper edge of the field close to farm using a leveling device to find the contour line. Further guide furrows are installed every 5 meters on the undulating ground and every 10 meters on an evenly sloping ground (Figure 34). 34). 34 Making a furrow guide Step 2 Working with each furrow guide, furrows are made halfway along the next guide furrow (Figure 35). Figure 35 Making furrow3.4 Irrigation furrow 3.4.1 Wetting Water models comes into every furrow from the field channel using siphons or spires (see annex 1). Sometimes instead of a field channel with siphons or spires, a closed pipe is used (Figure 36). Figure 36 Gated pipes Depending on the available flow in the farm canal, several furrows can be irrigated at the same time. If water is scarce, you can limit the amount of irrigation water used by alternative furrow irrigation. This includes irrigating an alternative furrow rather than every furrow. Figure 37 is an example of this procedure. Instead of irrigating each furrow after 10 days, furrows 1, 3, 5, etc. are irrigated after 5 days and furrows 2, 4 and 6, etc. are irrigated after 10 days. Thus, the harvest gets some water every 5 days instead of a large amount every 10 days. Small quantities, often applied in this way, are usually better for harvest than larger amounts applied after longer periods of time. Figure 37 Alternative furrow irrigation stock at the ends of the furrow can be a problem on the sloping ground. This can be up to 30 percent of the influx, even under good conditions. Therefore, shallow runoff should always be made at the end of the field to remove excess water. When no runoff is made, the plants may be damaged as a result of harvesting. Light vegetation that can grow in sewers can prevent erosion. Excessive runoff can be prevented by reducing the inflow after irrigation water has reached the end of the furrow. It's called cut irrigation. It is also possible to reuse the stock water further along the farm. 3.4.1 Wetting patterns In order to get evenly wet root zone, furrows must be properly delineated, have a single slope and irrigation water must be applied quickly. Since the root area of the ridge should be washed away from the furrows, the downward movement of water in the soil is less important than the lateral (or lateral) movement of water. Both the sideways and the downward movement of the water depends on the type of soil, as seen in Figure 38. Figure 38 Different models of wetting in furrows, depending on soil type (A - SAND) Figure 38 Different wetting patterns in furrows, depending on soil type (B - LOAM) Figure 38 Different patterns of wetting in furrows, depending on soil type (C - CLAY) Perfect wetting pattern In an ideal situation adjacent wetting patterns overlap, and there is a rising water movement (C - CLAY) Perfect wetting pattern In an ideal situation adjacent to wet patterns overlap, and there is an upward movement of water (capillation) that wet ridge (see figure 39), thus providing the root zone with water. Figure 39 Perfect Wetting Pattern To Get Even water along the length of the furrow, it is very important to have a single slope and a large enough flow size, so that the water water fast down the furrow. Thus, it is possible to avoid large losses of seepage at the head of the furrow. The quarter time rule is used to determine the time it takes to ensure that water is always from the farm canal to the end of the furrow to minimize the loss of precolation. The quarter time rule is further discussed in Annex 3. Bad wetting patterns Bad wetting patterns can be caused by: - unfavorable natural conditions, such as a compacted layer, different types of soil, uneven inclination; Poor layout, for example, too wide distance between furrows; - Poor management: Supply flow size that is too large or too small, stopping the influx too early. J. Unfavorable natural conditions Of compacted soil layers or different types of soil have the same effect on irrigation of the furrow as on the irrigation of the pool - see section 2.4.1. The solution to the problem is also similar. Uneven inclination can lead to uneven wetting along the furrow. Water flows quickly down steep slopes and slowly down flatter slopes. This affects the time available for infiltration and leads to poor water distribution. The problem can be overcome by regrading the land on a single slope. ii. Poor layout If the distance between the furrows is too wide (Figure 40), the root area will not be properly wet. The distance between the furrows requires careful selection to ensure adequate wetting of the entire root area (Figure 40). Figure 40 The distance between the two adjacent furrows is too wide iii. Poor management of too small flow size (Figure 41) will result in inadequate remagnification of ridges. Even if the plants are located on the sides of the ridge, not enough water will be available. The small size of the stream will also lead to poor water distribution along the length of the furrow. The progress will be slow and too much water will be lost due to deep seepage at the head of the furrow. Figure 41 The flow size is too small to get wet if the size of the creek is too large on the flat slopes, there may be an excess of the ridge (Figure 42). On steeper slopes with too large a stream size, the bed and side furrow may be eroded (Figure 42). Figure 42 Stream size is too large, causing flow or erosion Common control error is to stop the flow too early. This is usually done to reduce runoff, but this leads to poor distribution of water and plants, particularly at the end of the furrows do not get enough water. If the inflow of irrigation water is not stopped quickly enough, the runoff is excessive and the plants at the end of the furrow may drown when there is no adequate drainage system to evacuate excess water (see also annex 3.3.5 Methods of planting the location of plants in the furrow system is not fixed, but from natural circumstances. A few examples will be mentioned. - In areas with abundant precipitation, plants must stand on top of the ridge to prevent damage as a quality (Figure 43). - If the water is scarce, the plant it can put in a furrow itself to benefit greatly from the limited water (Figure 44). - Since salts tend to accumulate at the highest point, crops on salt soil should be planted away from the top of the ridge. Usually it is planted in two rows on the sides (figure 45). However, it is important to make sure that there is no danger of harvesting. - For winter and early spring crops in colder areas, seeds can be planted on the sunny side of the ridge (Figure 46). In hot areas, seeds can be planted on the shady side of the ridge to protect them from the sun. Figure 43 Harvest Protection Figure 44 Water Shortage Protection Figure 45 Protection from Salt Accumulation Figure 46 Winter and Early Spring Crops: Seeds Planted on the Sunny Side of the Ridge3.6 Serving furrows after the construction of a furrow system should be maintained regularly; During irrigation, check if the water reaches the down end of all furrows. There should be no dry spots or places where water remains prudential. The flow of ridges should not occur. Field channels and drains should be free of this kind. Weeds. 