

DIAGNOSIS
STAND ESTABLISHMENT

May, 1984.

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I. EQUIPMENT FOR TILLAGE

Equipment used for tillage ranges from sophisticated machinery to simple hand tools. Choice of equipment depends on the farmer's resources, the amount of land to be cultivated, and the availability of various alternatives. Farmers may have access to tractors through direct or cooperative ownership, or rental. Access may also be limited by fuel costs and maintenance problems. Access to draft animals and equipment may also be through ownership or rental. The number of draft animals in an area may be limited by the costs of caring for the animals and providing feed throughout the year. Tillage may also be carried out by hand. Labor availability is crucial here.

Choice of equipment also depends on the characteristics of the plot. Larger fields are obviously less likely to be worked with hand tools. The slope will determine whether or not tractors, or even animals, will be appropriate. The type of soil is also an important factor. Harder soils are less easily worked by hand or animals, for instance. Poorly drained soils may require the deeper tillage which a tractor can provide.

Questions and Observations

- What type of equipment is used for tillage?
- If equipment is rented, what factors determine the type the farmer uses (accessability, cost)?
- What are the costs of renting equipment.
- If labor is used in tillage, what is its source?
- Describe the soils of the area (type, depth).
- How does soil type affect the tillage equipment used by farmer?

- How does slope affect type of tillage equipment used?

2. TIMING OF TILLAGE OPERATIONS

The number and timing of tillage operations are determined by several factors. Early tillage may be very useful for moisture conservation, especially in semi-arid areas. It may not be carried out, however, because of lack of equipment, soil conditions, or the need to use the field as a source of grazing. Secondary tillage operations are also conditioned by the availability of equipment and/or labor and the condition of the soil (related to timing of rains) and drainage properties of soil. Secondary operations may be timed to control weeds just before planting or to incorporate fertilizer. Several separate operations may be the ideal, but if there is a shortage of equipment and/or labor tillage and planting may be combined in a single operation.

Questions and Observations

- How many operations are performed prior to planting?
- When are they performed?
- Is it always the same number? If not, what determines the number of tillage operations.
- How does rainfall and drainage affect the amount of tillage and the type of equipment used?
- When are these operations carried out in relation to rainfall?
- What is weed growth like during the period when tillage operations are being carried out?
- Is there evidence of beneficial effects of moisture conservation through early tillage in the research area?

- How does the availability of equipment and/or labor affect the number and type of tillage operations?
- What other work does the farmer have at the time of tillage (other crops, other activities)?
- Are tillage and planting operations ever combined? Why?
- Is a levelling operation included in land preparation?
- Is some form of ridging used?
- Is fertilizer application timing determined by tillage operation or vice versa?

3. TILLAGE IN RELATION TO PREVIOUS CROP

Tillage operations are conditioned by the nature of the previous crop. The previous section pointed to the case of farmer's needs for grazing limiting the possibility for early tillage. Stubble may be left for grazing, or weed growth may be utilized for the same purpose.

If crop residues are left in the field, this may affect time and type of tillage. Farmers may try to incorporate the residues early or, if they do not have adequate equipment may leave them on the surface for some time to decompose. Crop residues may be burned prior to, or in place of, tillage operations. The burning may either make tillage easier or be done in place of tillage. Burning may also serve to control weeds and to control insects or other pests.

Questions and Observations

- Which crops usually precede the target crop in the rotation?
- How is tillage determined by rotation pattern?

- What does the farmer do with residues from the previous crop? Are residues left to decompose on surface or ploughed in, or are they burned before planting time?
- Are there other reasons for burning residues?
- Does the farmer have access to equipment for incorporating crop residues?

4. PLANTING WITHOUT TILLAGE

There are many instances where farmers plant without moving the soil. These range from slash and burn systems to sophisticated methods of chemical zero tillage. These methods have the advantage of saving labor and may also make valuable contributions to soil conservation. To be successful, they must include an adequate method for weed control and provide an appropriate seed bed.

Questions and Observations

- What reasons do farmers have for not tilling before planting (shortage of equipment/labor, erosion control, slash and burn system, etc.)?
- What kind of a cover exists at planting time (killed weeds, crop residues, ash, etc.)?
- If herbicides are used, what are they and how are they obtained?

5. SEED BED

The final form of the seed bed is an important determinant of stand establishment. If the crop is to be broadcast the field should be well-tilled, but this is sometimes not possible because of shortages of

time or equipment. For row crops, rows may be formed in various ways and with various purposes. Furrows may be made to help drainage or for irrigation purposes. Fields may be ridged for soil or water management.

Questions and Observations

- For broadcast crops, is the soil finely divided, or are there large clods?
- Are there drainage problems? Is the field liable to be waterlogged at planting time?
- For row crops, are furrows or rows made mechanically? What is their spacing, depth?
- Do the furrows serve other purposes, such as soil or water management?
- Are any mounds made for planting the crop? How are these made and why?
- What is the weed population in the field at planting time?

6. TIMING OF SEEDING

The time of seeding is conditioned by a number of factors. These include the time it takes to prepare the land, rainfall patterns, competing activities, climatic, pest and disease conditions related to planting date, and the farmer's targets for harvesting date.

Questions and Observations

- When is planting done in relation to the last tillage operation?
- How does the rainfall pattern affect planting time? Do farmers wait for the first rains? Do heavy rains delay planting?

- Do farmers dry plant?
- Are there other activities which compete for labor at planting time?
- To what extent does access to equipment and/or labor for tillage affect planting date?
- What characteristics of the growing season affect planting date:
 - Differential disease or pest incidence related to planting date.
 - Late season frosts, droughts or high temperatures which encourage early planting.
 - Mid-season droughts which influence time of planting.
- Is there one single planting, or do farmers stagger their planting?
- If planting is staggered, is it because of labor/equipment constraints, because farmers try to have a series of harvest dates, or because they want to stagger other operations, such as weeding?
- Does the end use of the crop help determine planting date?

7. SEEDING METHOD

Seeding of small grains may be done broadcast or in continuous rows. Larger grains may also be broadcast, but are more often placed by hand or with a machine.

In the case of broadcasting, the seed must be incorporated with the soil. Effectiveness of incorporation is determined by the type of equipment used and the condition of the seedbed. Uneven depth of seeding may result in poor emergence, but may also be a way of reducing risk by sowing seed at different depths as a hedge against uncertain moisture conditions.

When seed is individually placed it may be in holes or continuously dribbled. If placed in holes, these may be made by a stick, hoe or other instrument, depending (among other things) on the type of soil (heavier soils favoring the small holes made by a stick). The holes may be randomly placed or in a row. If a furrow had been made, the holes may be found at the top of the ridge, bottom of furrow, or in between, depending on such things as moisture conditions and later crop management practices. Seed may be covered by a variety of methods. Seeding depth is determined by moisture conditions, the presence of birds and other pests, etc.

If machinery (planters, seeders) is used, it may belong to the farmer or be rented. The type of machinery available may affect seeding rate.

Questions and Observations

A. Broadcasting

- Is the seed broadcast by hand?
- Who are the people who do the broadcasting?
- How is the seed incorporated?
- How evenly is it incorporated, and at what depth(s)?
- If seed depth uneven, any evidence of advantages or disadvantages?

B. Seed Placement

- By hand, or some form of precision drill or planter?
- Is seed planted in rows, or at random?
- If in rows, is it dribbled continuously, or placed in holes?

- If in rows, how are the rows formed?
- If there are furrows, where are the seeds placed on the ridge? What is the reason for this placement?
- How are the holes made? How are they covered?
- What determines the depth of the holes?
- What type of labor is used for planting?

C. Machinery Planting

- What type of machinery is used?
- How is the machine calibrated (seed rate, seed depth)?
- What types of fields, soils can the machinery not be used on?
- What is the source of the machinery?
- If a drill is used, is fertilizer also applied with the drill?

8. INTERCROPPING

It must be kept in mind that more than one crop may be planted in the same field. Several crops may be planted at the same time, one after another, or in relay cropping. These practices will obviously affect the planting practices in the target crop.

(For more on intercropping, refer to guidelines on "Characteristics of the Growing Season")

9. DENSITY AND SPACING

The quantity and spacing of seeds depends on a number of factors. High quantities of seed may be used to ensure adequate germination; higher quantities may also be used if the farmer uses at least part of

the harvest for forage. Low quantities of seed may be used if the farmer feels there is danger of stress, such as from low moisture.

Spatial arrangement is determined in part by the way the field is prepared and the amount of labor available for planting. In addition, plant spacing may facilitate later operations, such as weeding.

The difference between density and spatial arrangement should always be kept in mind, and researchers should be aware of the implications in fertility, moisture, weed growth, plant vigor and labor use occasioned by trade-offs between density and spacing.

Questions and Observations

- What is the seeding density in kg of seed or number of plants per hectare?
- Does the farmer use a part of the harvest as forage?
- Are high densities used to help control weeds?
- If the density is low, is there evidence of problems with moisture, or other factors which would encourage low densities?
- Do density and spacing depend on the variety planted?
- Does farmer vary density and spacing depending on other factors (date, drainage, seedbed quality, etc.)?
- How much labor is available for planting, and how does this affect spatial arrangement?
- Do later operations, such as weeding, fertilization, or the planting of intercrops, help determine spatial arrangement?
- If the crop is planted individually, examine the number of plants

per position, and the distance between positions. What are the advantages and disadvantages of this type of arrangement?

- Is there evidence of excessive competition (barren ears, small ears, few spikes per plant, etc.)?

10 GERMINATION

The timing and completeness of germination are determined by such factors as soil temperature, moisture, depth of seeding, soil oxygen content, seed quality, and soil insects and pathogens. Farmers may treat seeds to help germination. If germination is low, farmers may have to replant.

Questions and Observations

- How many days between planting and emergence?
- What are temperature and moisture conditions at this time?
- What proportion of plants emerge? How is the emergence spread over time?
- What is the plant stand after germination? (Need note on taking stand counts)
- Does rainfall or irrigation ever cause a cap on the soil which inhibits emergence? Is this related to excessive tillage?
- What is the source of seed? Is there evidence that it may be of poor quality? (Instructions on germination test)
- Is there evidence of soil insects or pathogens? (Instructions on simple test for soil pathogens)
- Do farmers treat their seeds before planting? With what? Against what?

- Do farmers do anything else to discourage pests such as birds at time of germination?
- Do farmers ever replant their fields? How is this done? How does the farmer decide to replant?
- (Guidelines for observations in field. Early seedling growth and tillering. Evidence of nitrogen or moisture deficiency. Root growth, diseases, etc.)