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Choosing Between 8-Row and 4-Row Regular-Perforated Pipes

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1. Overview of regular-perforated pipes

Drainage pipe manufacturers make drain pipe (tile) with different perforation shapes, sizes, and patterns. The perforation shape is rectangular slot, circular hole, or oval hole. The perforation size refers to width and length for rectangular slots, and diameter for circular slots. The perforation pattern refers to their arrangement around the pipe (staggered or non-staggered), perforation location (inside the valleys or on the crown), and number of perforation rows. A pipe with 4 rows of staggered regular-perforations and 8 rows of non-staggered regular-perforations is illustrated in Figure 1.

While manufacturers make different pipes in the USA and Canada, the most manufactured pipe is the 4-row regular-perforated pipe with rectangular slots in the valleys. This bulletin compares the properties of two 4-inch diameter pipes: 8-row and 4-row regular-perforated pipes. The evaluated properties include water entry into the pipe and water-table drawdown. This bulletin is based on scientific research conducted on commonly manufactured pipes in the Midwest USA (Ghane, 2022a; Ghane et al., 2022).

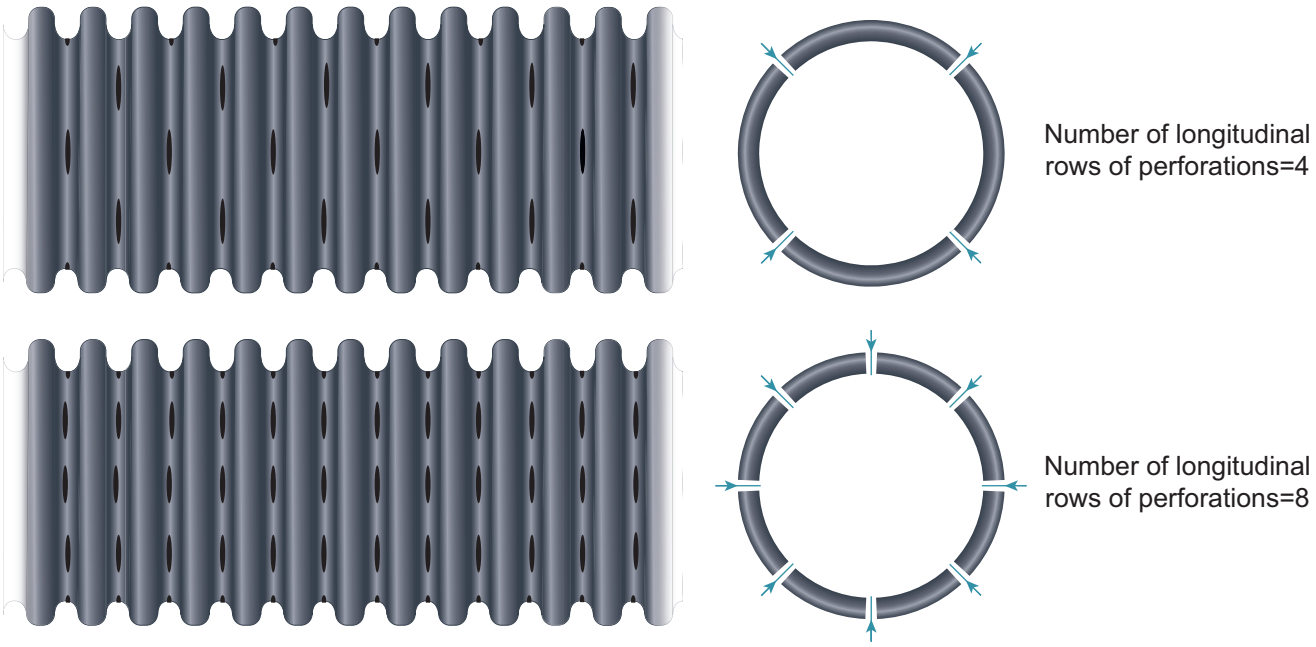


Figure 1- Top: A staggered regular-perforated pipe with 4 perforation rows per valley, rotated 45 degrees every other valley. Bottom: A non-staggered regular-perforated pipe with 8 perforation rows per valley.

2. Where are regular-perforated pipes suitable?

Both 8-row and 4-row regular-perforated pipes are suitable in soil without a drain sedimentation problem. Generally, soil with greater than 30% clay content is less likely to be susceptible to drain sedimentation. These soils have cohesive particles that stick together to resist being washed into the drain pipes. Use a sock-wrapped or sand-slot pipe in soil with a drain sedimentation problem. For more information about those pipes, see Ghane (2022b).

3. An 8-row pipe has a higher drain inflow than a 4-row pipe

Water enters an 8-row pipe more quickly than a 4-row pipe, so an 8-row pipe has a higher drain inflow than a 4-row pipe. This is because an 8-row pipe has a greater number of slots per foot than a 4-row pipe.

The percent increase in drain inflow of an 8-row pipe compared to a 4-row pipe depends on drain depth, drain spacing, and depth to restrictive layer. For example, a 4-inch diameter 8-row pipe has 11% more drain inflow than a 4-row pipe, when installed at 30-ft spacing and 2.5-ft depth in soils with varying saturated hydraulic conductivities and a depth to restrictive layer of 6.5-ft (Figure 2). This difference grows to 12%, if the drains are installed at 20-ft spacing, while other conditions are the same. Overall, the trend of higher drain inflow for an 8-row pipe than a 4-row pipe will remain the same for other combinations of conditions.

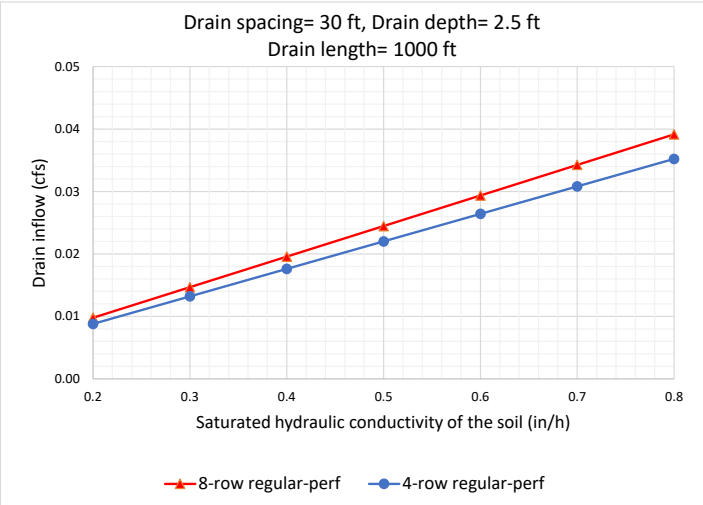


Figure 2- An 8-row regular-perforated pipe has 11% higher drain inflow than a 4-row pipe, when installed at 30-ft spacing and 2.5-ft depth. Depth to restrictive layer is 6.5 ft.

4. An 8-row pipe lowers the water table more quickly than a 4-row pipe

When installed at the same depth and spacing, an 8-row pipe lowers the water table more quickly than a 4-row pipe. The time to lower the water table from the soil surface to 1-ft depth depends on the pipe material, drain depth, drain spacing, and soil properties. For example, an 8-row pipe lowers the water table 2.6 hours more quickly than a 4-row pipe, when installed at 30-ft spacing and 2.5-ft depth in a clay loam soil with a saturated hydraulic conductivity of 0.4 in/h, depth to restrictive layer of 6.5 ft, and drainable porosity of 0.04 (Figure 3).

The quicker lowering of the water table with an 8-row pipe reduces the risk of crop damage from waterlogging after heavy rainfalls. It also reduces the risk of delayed planting because of wet soil.

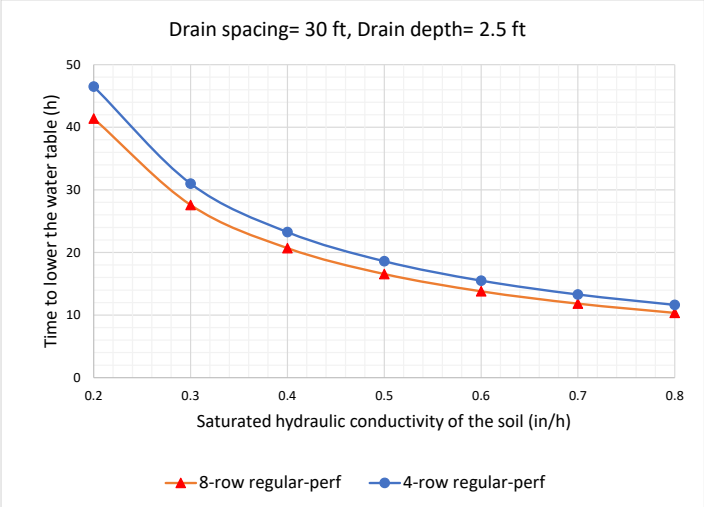


Figure 3- An 8-row regular-perforated pipe lowers the water table from the soil surface to 1-ft depth, 11% more quickly than a 4-row pipe, when installed at 30-ft spacing and 2.5-ft depth. Drainable porosity is 0.04 and depth to restrictive layer is 6.5 ft.

5. What pipe properties increase drain inflow?

5.1. Increasing the number of perforation rows increases drain inflow

Assume a pipe has 18 counts of slots per foot, and another pipe has 8 counts of slots. Both pipes have an equal water inlet area (Figure 5). For a given water inlet area per foot, drain inflow is higher in the pipe with the greater subdivision of openings. A greater subdivision of openings can be achieved by increasing the number of perforation rows, while having perforations in each valley. As a result, the number of perforation rows is the most important pipe property affecting how fast water enters the pipe.

5.2. Increasing the slot length increases drain inflow

Assume a 4-inch diameter 4-row staggered pipe with longer, shorter slots, and another pipe with shorter, wider slots. Both pipes have the same perforation rows and pattern. Both pipes have an equal water inlet area per foot. The pipe with the longer, narrower slots has a higher drain inflow than the pipe with the shorter, wider slots. As a result, slot length is the second most important pipe property affecting how fast water enters the pipe. Increasing slot width has a minimal effect on drain inflow.

5.3. Increasing water inlet area does not necessarily increase drain inflow

Water inlet area per foot has a weak relationship with drain inflow. As shown in sections 5.1 and 5.2, two pipes with an equal water inlet area per foot can have different drain inflows depending on their perforation shape and pattern. A pipe with a higher water inlet area does not necessarily have a higher drain inflow. A better indicator of drain inflow is perforation shape and pattern.

5.4. Pipe material affects drain inflow

It is a misconception that increasing perforation rows will not increase drain inflow in heavy clay soil because water cannot move through the soil fast enough. However, as shown in Section 3, an 8-row pipe had 12% more drain inflow than a 4-row pipe, when installed at 20-ft spacing and 2.5-ft depth in a heavy clay soil with a saturated hydraulic conductivity of 0.2 in/h. Therefore, pipe material affects drain inflow, even in heavy clay soil with a very low saturated hydraulic conductivity.

Consider pipe material when sizing the main pipe in drainage design. Pipe material affects drainage intensity, which is a measure of the rate of water movement through the soil into the drain pipes. The main pipe should be sized with a drainage coefficient that is greater than or equal to drainage intensity.

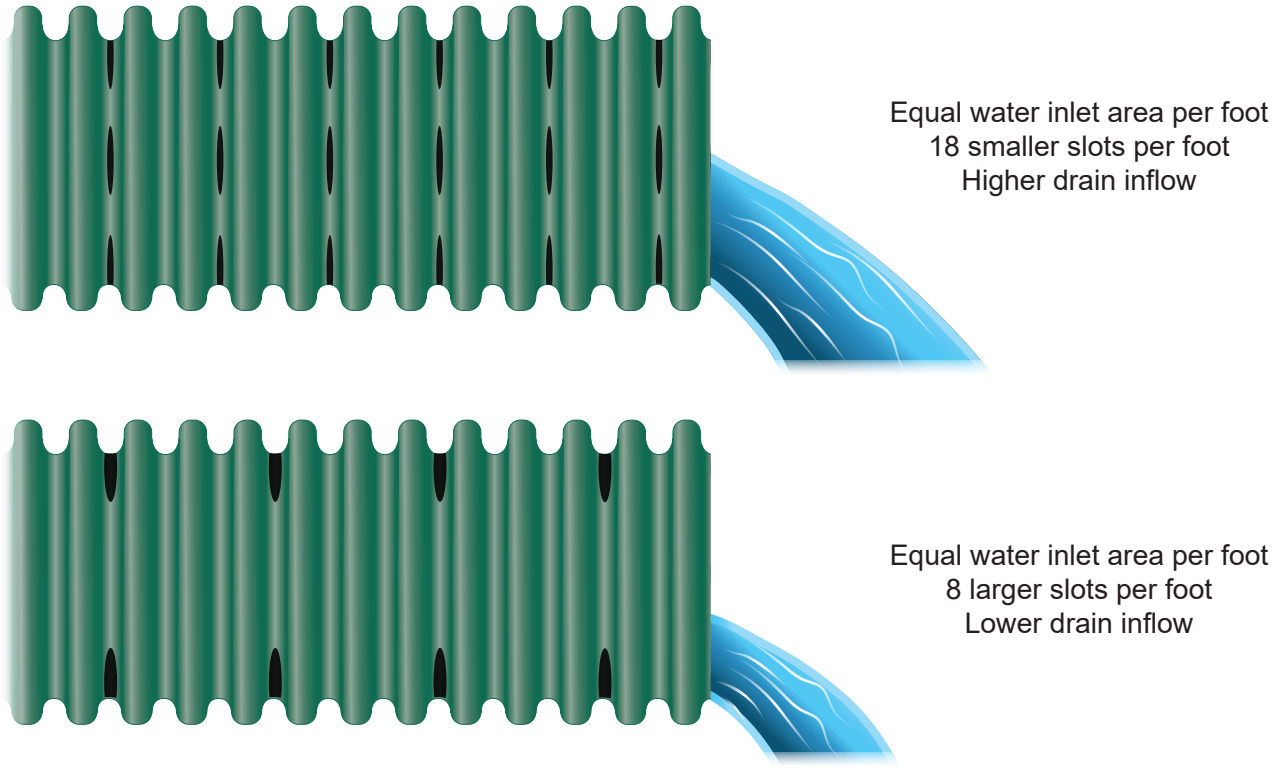


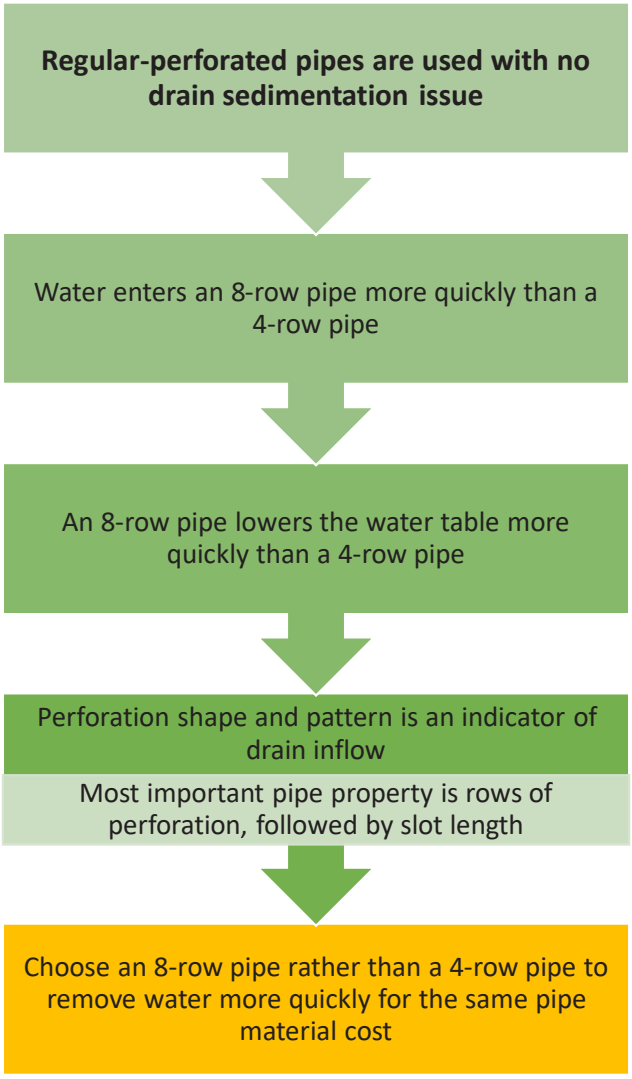
Figure 4- The pipe with the greater subdivision of openings has a higher drain inflow. Greater subdivision of openings can be achieved by increasing the number of perforation rows.

6. Conclusions and recommendations

Water enters an 8-row regular-perforated pipe more quickly than a 4-row pipe. When installed at the same depth and spacing, an 8-row pipe lowers the water table more quickly than a 4-row pipe. Lowering the water table more quickly reduces the risk of crop damage from waterlogging after heavy rainfalls. It also reduces the risk of delayed planting because of wet soil.

A pipe with a higher water inlet area does not necessarily have a higher drain inflow. A better indicator of drain inflow is perforation shape and pattern. The most important pipe property affecting how fast water enters the pipe is the number of perforation rows, followed by slot length. Slot width has minimal effect on drain inflow.

If installing a drainage system, choose an 8-row pipe rather than a 4-row pipe to remove water more quickly for the same pipe material cost.



Expert Reviewed

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References

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