

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

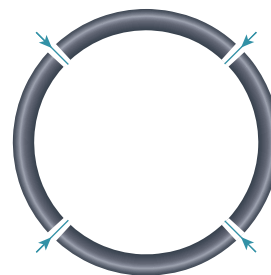
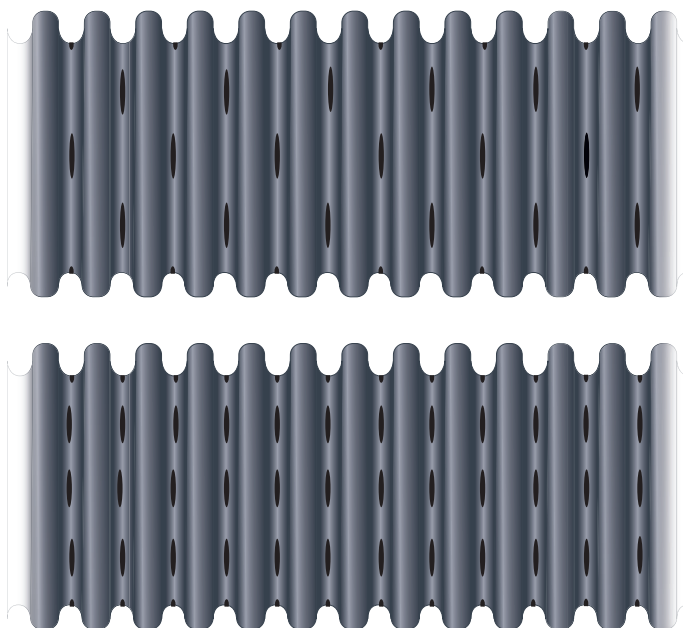
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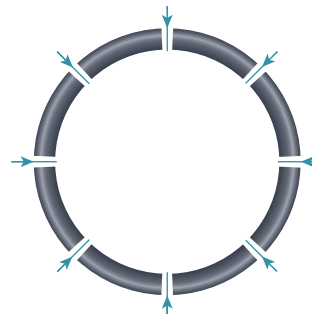
1. Overview of regular-perforated pipes

Drainage pipe manufacturers make drain pipe (tile) with different perforation shapes, sizes, and patterns. The perforation shapes are rectangular slot, circular hole, and 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 regular-perforated pipes: 8-row and 4-row. 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, 2022; Ghane et al., 2022).



Number of longitudinal rows of perforations=4



Number of longitudinal rows of perforations=8

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 (2025).



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

Water enters an 8-row pipe faster 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.

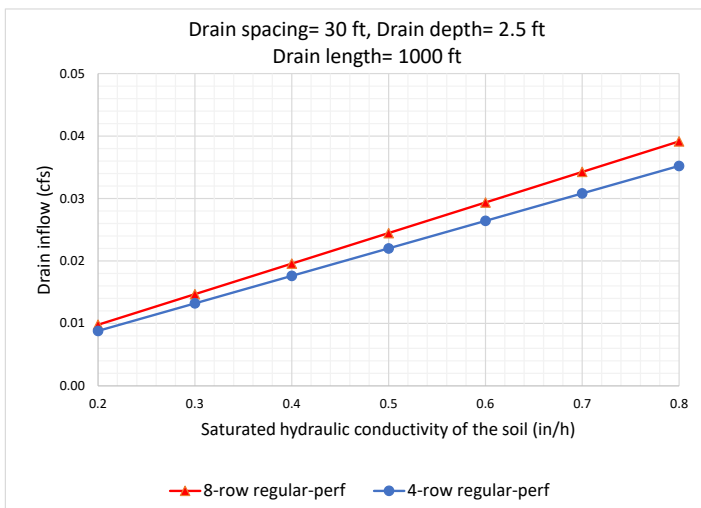


Figure 2- An 8-row regular-perforated pipe has 11% higher drain inflow than a 4-row pipe, when installed at 30-ft spacing and 2.5-ft depth. Depth to restrictive layer is 6.5 ft.



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

When installed at the same depth and spacing, an 8-row pipe lowers the water table faster than a 4-row pipe. The time to lower the water table from the soil surface to 1-ft depth depends on the pipe perforation pattern, drain depth, drain spacing, and soil properties. For example, an 8-row pipe lowers the water table 2.6 hours faster 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.

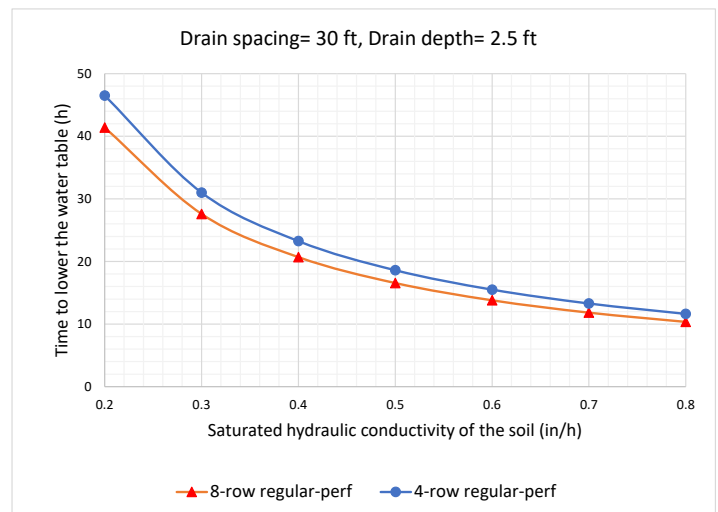


Figure 3- An 8-row regular-perforated pipe lowers the water table from the soil surface to 1-ft depth, 11% faster than a 4-row pipe, when installed at 30-ft spacing and 2.5-ft depth. Drainable porosity is 0.04 and depth to restrictive layer is 6.5 ft.



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. Therefore, 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 perforated pipe with longer, narrower 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. This is because slot width has a minimal effect on drain inflow, and slot length has a large effect on drain inflow. Therefore, slot length is the second most important pipe property affecting how fast water enters the pipe.

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

Water inlet area per foot has a weak relationship with drain inflow. A pipe with a lower water inlet area (many small, long and narrow slots) can have a greater drain inflow than a pipe with a higher water inlet area (a few large, short and wide slots). This is because increasing the number of rows and length of slots has a greater effect on drain inflow than increasing slot width. As a result, a pipe with a higher water inlet area does not necessarily have a higher drain inflow. Therefore, perforation shape and pattern are better indicators of drain inflow than water inlet area.

5.4. Perforation pattern affects drain inflow

As discussed in section 5.1, using an 8-row pipe rather than a 4-row pipe increases drain inflow. There is a common misconception that this is not true for heavy clay soil because the movement of water to the pipe is already limited by the soil. However, even in a heavy clay soil with a saturated hydraulic conductivity of only 0.2 in/h, the 8-row pipe had a 12% greater drain inflow than the 4-row pipe when installed with a 20-ft spacing and a 2.5-ft depth. Therefore, perforation pattern affects drain inflow, even in heavy clay soil.

5.5. Regular-perforated and sand-slot pipes

Both 4-row sand-slot and regular-perforated pipes have similar drain inflow even though sand-slot pipes have a narrower slot width. This is because slot length has a much larger effect on drain inflow than slot width, and both pipes have generally the same slot length.

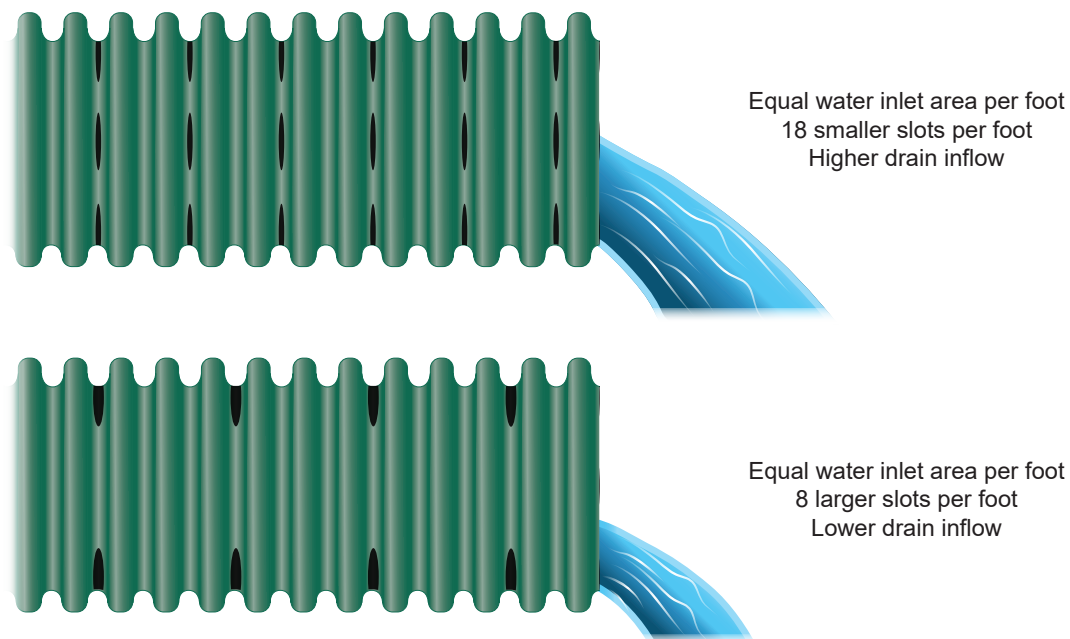


Figure 4- The pipe with the greater subdivision of openings has a higher drain inflow. Greater subdivision of openings can be achieved by increasing the number of perforation rows.

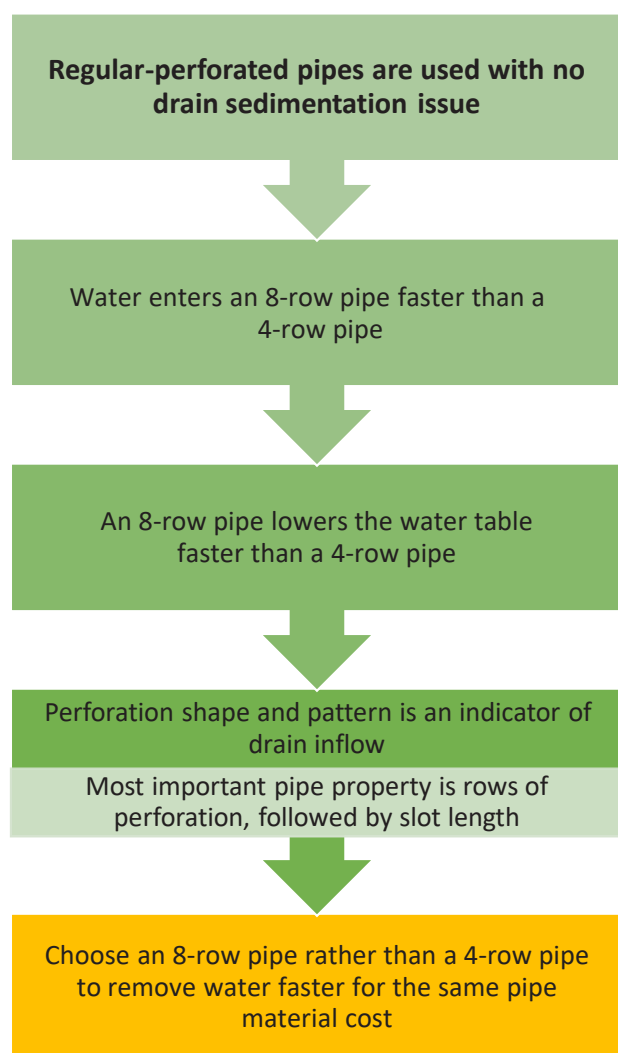
6. Conclusions and recommendations

Water enters an 8-row regular-perforated pipe faster than a 4-row pipe. When installed at the same depth and spacing, an 8-row pipe lowers the water table faster than a 4-row pipe. Lowering the water table faster 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. Perforation shape and pattern are better indicators of drain inflow than water inlet area. Perforation pattern affects drain inflow, even in heavy clay soil. Both 4-row sand-slot and regular-perforated pipes have similar drain inflow.

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 faster for the same pipe material cost.



Expert Reviewed

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References

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