Osmosis Is Serious Business!

by
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Part I—Too Much of a Good Thing

Times were difficult in Habersham County. The skyrocketing prices of fuel and food were threatening to bankrupt the Johnson family's small farm, which was no match for the multi-million-dollar mega-farms that had been popping up all over the southeast. Joseph, the family patriarch, was especially troubled by the farm's financial circumstances. He knew that this year's corn crop was his best chance to save the farm, and his distress was evident to his family as they sat around the dinner table.

"Michael, I'm going to need your help tomorrow," Joseph said to his eldest son. "I have to go into town to pick up a part for the combine so I can fix it before it's time to harvest in a few months. I need you to spread the potash and phosphate on the corn because we're expecting some rain by the end of the week."

Michael, his mouth full of fried chicken, nodded in agreement. He wasn't all that interested in farming, which over the years had been a point of contention between him and his father. At the moment Michael was thinking more about the time he'd be missing with his friends, but he also realized how vital this chore was to his father and the farm. "I'll do it right after school, Dad," he replied.

The following afternoon, Michael was loading heavy bags of fertilizer into the drop spreader on the farm tractor. His father's cheerless demeanor the previous evening weighed heavily on him. Michael knew that 25 bags of the potassium and phosphorous-based fertilizer was the normal load to cover the 40 acres of corn the family had planted that spring. But as he was emptying the 25th bag into the spreader, an idea flashed through his mind: "If we need a good corn crop to make it, maybe I should add a little extra fertilizer." Michael decided that some extra fertilizer couldn't hurt, so he quickly loaded 15 extra bags. He was certain that adding the extra fertilizer would produce a massive crop when it came time to harvest in a few months.

Michael hadn't told his father about the extra fertilizer he'd added to the corn, wanting to see his father's surprise over the size of the harvest in a few months. As expected, the rain started Friday afternoon; Michael was certain it would start an incredible growth spurt in the newly fertilized, young corn plants and that his family would hit pay dirt in a few months. He was out of bed early on Saturday morning, taking his four-wheeler down to the cornfields. He expected to see a vibrant green sea of young corn, extra healthy due to the fertilizer "boost" he had given them. His stomach dropped a bit as he stared out at a field of sickly looking corn plants, their leaves pale green and slightly wilting. "Maybe it rained too hard and that beat the plants up a little," thought Michael, trying to be optimistic. "I'll check on them again in a few days. I'm sure they'll have perked up by then!"

The next few days didn't bring the results Michael was hoping for. The corn plants looked even worse! The leaves were beginning to yellow significantly and were continuing to wilt. Having watched his father grow corn for most of his 14 years, Michael knew this crop wasn't going to make it. A lump was forming in his throat as he made his way back to the house, not sure how to tell his father about the corn.

Questions

1. What sort of environment (hypotonic, hypertonic, isotonic) did the extra fertilizer create around the roots of the corn? Justify your answer.
2. Keeping in mind your answer to the previous question, what do you believe caused the corn plants to wilt and eventually die? Justify your answer
3. If Michael's mistake had been caught earlier, is there anything that could have been done to prevent the corn from dying?
4. Generally, people water their plants with 100% H_2O—no solutes added. What sort of environment does this create around the roots of the plant?
5. Briefly explain why plants generally thrive in this sort of environment.