

SOIL | PLANTS | PEOPLE | A HEALTHY PLANET

Why PQNK Sugarcane Tillers From the Inside

Apical dominance, the mother shoot and the living soil: a field observation explained

Cut the mother shoot and the stool fills from the centre, with tillers of one age rising together over the root zone. Leave it, and tillering creeps outward, one uneven generation after another.

Abstract

A PQNK grower, Vasudha Sardar, keeps two sugarcane plots side by side. On the PQNK plot, where the mother shoot of each stool is cut early, new tillers come up from inside the stool. On the conventional plot, where the mother shoot is left, new tillers appear on the outside. The soil of the two plots is also strikingly different. This paper explains both observations. Tillers grow from buds on the short underground nodes at the base of a shoot, and the mother shoot's own buds sit at the centre of the stool. While the mother shoot grows, the hormone auxin flowing down from its tip, reinforced by strigolactones, holds those central buds dormant, so tillering spreads outward one generation at a time. Cutting the mother shoot removes that hold: the central buds break together, pushed by cytokinins and sugars from a root system that, in living soil, is vigorous. The result is a compact stool of tillers of one age, uniform in height and girth, standing over the root zone on the centre of the bed.

1. The Field Observation

Vasudha Sardar grows sugarcane on two plots: one under PQNK, on permanent beds with organic mulch, where the mother shoot of every stool is cut early, and one under conventional management, where the mother shoot is left to grow. Walking both plots, she noticed that the new tillers on the PQNK canes were coming from inside the stool, while on the conventional canes, and on any stool whose mother shoot had not been cut, the new tillers were coming from the outside. She also saw a great difference in the soil. Her question was simple: what is the significance of this?



Figure 1. PQNK sugarcane, mother shoot cut: new tillers rise from the centre of the stool in a compact clump, on dark, moist, mulched soil with living green cover. Photos: Vasudha Sardar.



Figure 2. Conventional sugarcane, mother shoot not cut: the mother shoot stands at the centre and tillers spread from the outside, on pale, dry, crusted soil with the drip line on the surface. Photos: Vasudha Sardar.

2. How a Sugarcane Stool Is Built

A cane set germinates from its bud into a single primary shoot, the mother shoot. Its lowest internodes stay short and remain below the soil surface, and each of these underground nodes carries a bud. Those buds give rise to the first tillers. Each tiller in turn has short basal nodes of its own, with buds that give the next generation of tillers, and so on. The mother shoot's basal buds therefore sit at the very centre of the stool, and each later generation of tillers starts a little further out. Which buds break, and when, decides the shape of the stool.

3. Apical Dominance: Why Buds Wait

The growing tip of a shoot produces auxin, a plant hormone that moves down the stem. While it flows, the buds below the tip are held dormant. This is apical dominance. Auxin does not act alone. It raises the production of strigolactones, hormones that keep buds closed, and it lowers the supply of cytokinins, the hormones that the roots send up to make buds grow. The growing tip also draws the plant's sugars to itself, so the buds below are short of the energy they need to start. Whether a bud breaks depends on this balance: auxin and strigolactones hold it back; cytokinins and sugar push it forward.

4. When the Mother Shoot Is Left: Tillering From the Outside

As long as the mother shoot keeps growing, its tip holds the buds closest to it, the basal buds at the centre of the stool, under the strongest control. Tillers break slowly, and each new tiller sets up its own small zone of dominance, so the next tiller breaks from the base of the previous one, further out. The stool spreads outward, one generation after another, and ends up with tillers of

How a Sugarcane Stool Builds: The Mother Shoot Decides

Basal nodes with buds are below the soil surface. The mother shoot's buds are at the centre of the stool.

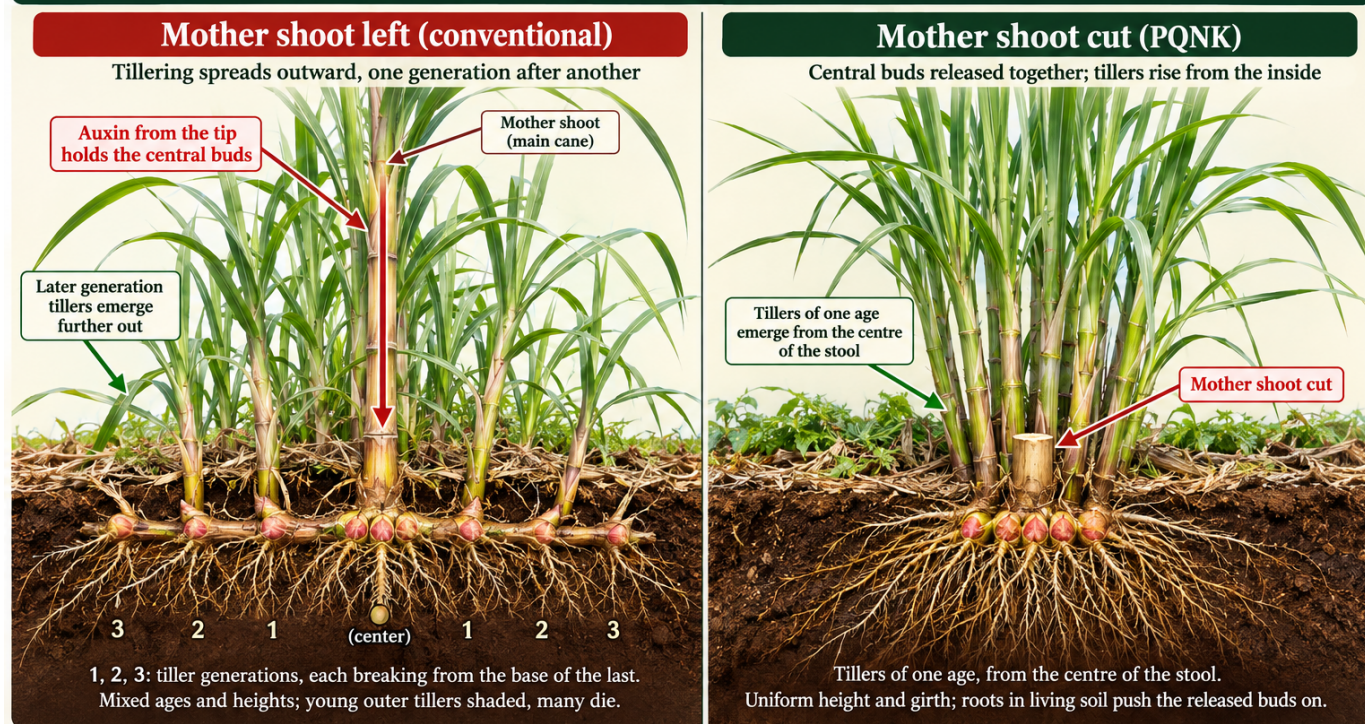


Figure 3. How the stool builds. Left: with the mother shoot left, auxin from its tip holds the central buds, and tillers break from the base of earlier tillers, generation by generation, further out. Right: with the mother shoot cut, the central buds break together and tillers of one age rise from the inside.

different ages and heights: the oldest at the centre, the youngest at the edge, shaded by the taller ones within. Many of these late outer tillers don't become millable cane or even die before they become canes. Conventional practice responds by piling soil around the stool, earthing up, to suppress them. The result is an uneven stand: one dominant cane with weaker followers.

5. When the Mother Shoot Is Cut: Tillering From the Inside

Cutting the mother shoot removes the source of the auxin signal at the centre of the stool. With the hold released, the buds at the base of the mother shoot, right at the centre, break together, pushed by the cytokinins coming up from the roots and by the sugars that the cut shoot no longer takes. The new tillers rise from inside the stool, all of nearly the same age, in a compact clump, exactly as Vasudha's PQNK photos show. Because they start together, they grow to the same height and girth and mature together, as Chapter Thirty-Seven and KP-211 describe: instead of one dominant cane with weaker, uneven followers, the released tillers develop as a uniform population of millable canes. Because they stand over the centre of the permanent 42-inch bed, above the root zone, the stool is firmly anchored and needs no earthing up.

Timing matters. The leader is not allowed to grow to maturity: within a few weeks of emergence, once several secondary tillers have developed enough leaf area for photosynthesis, it is removed (KP-211). By then the plant has the leaf area to feed the buds that are about to be released.

6. The Soil Behind the Stool

The second thing Vasudha saw explains the first. The PQNK soil is dark, moist and crumbly, covered with mulch and living green cover. It is biologically active, it stays cool, about 30 to 33°C under mulch in summer heat against 70°C or more on bare soil (Chapter Thirty-Eight), and it holds water, including the dew that settles on the mulch overnight. The conventional soil is pale, dry and crusted, bare to the sun, with the drip line lying on its surface: it is losing organic matter, and it heats and dries even under drip irrigation.

Bud release depends on the roots. A vigorous root system in cool, moist, living soil supplies the cytokinins, water and minerals that push the released buds on quickly and strongly, and it keeps feeding every tiller that follows. A root system in hot, dry, degraded soil cannot. The shape of the stool and the colour of the soil are two views of the same thing: when the soil is alive, the plant responds to good management as it is designed to.

7. What This Means for the Farmer

The PQNK sugarcane sequence stays as set out in KP-211 and Chapter Thirty-Seven: one-time hardpan correction, centre planting on the permanent 42-inch bed, unrestricted rooting, no earthing up, early removal of the leader to manage apical dominance, uniform tiller development, and selective or circular harvesting where practicable. This paper adds the reason behind the step the farmer sees: when the mother shoot is cut at the right time, new tillers rise from the inside of the stool, and that is the sign that apical dominance has been broken and the stool is building as it should. Keep the bed mulched, give water only when the soil-ball test shows a need and never above a 4-inch head, and let the living soil carry the tillers on.

Conclusion

Vasudha's two plots show apical dominance at work in the field. Where the mother shoot is left, its tip holds the central buds, and the stool spreads unevenly from the outside. Where it is cut, the central buds are released together, and a uniform stool rises from the inside, driven by roots in living soil. The difference in the soil is not a side issue: it is what makes the difference in the plant.

PQNK Principle: Break the leader's hold early and keep the soil alive. The stool will fill from the centre, with canes of one age.

Scientific Background

1. Domagalska, M. A. and Leyser, O. (2011). Signal integration in the control of shoot branching. *Nature Reviews Molecular Cell Biology* 12, 211–221.
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Related PQNK Sources

1. PQNK Knowledge Paper KP-211: Why PQNK Sugarcane Does Not Need Earthing Up. <https://pedaver.com/papers/why-pqnk-sugarcane-does-not-need-earthing-up/>
2. PQNK Book, Chapter 37: Sugarcane. <https://pedaver.com/books/natural-ecosystem-science/sugarcane/>
3. PQNK Book, Chapter 38: Potato (mulch and soil temperature). <https://pedaver.com/books/natural-ecosystem-science/potato/>

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