Molecular Devices QPix XE: A compact, cost effective, high throughput microbial colony picker for synthetic biology workflows

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Abstract

Synthetic biology applies a Design-Build-Test-Learn (DBTL) approach to molecular cloning techniques, allowing us to engineer new strains of organisms and their building blocks to generate new therapies, vaccines, and diagnostics for clinical applications or to mitigate environmental challenges such as our dependence on fossil fuel consumption. The DBTL approach used in strain engineering has an almost limitless potential to design and develop large, diverse libraries of biological strains. This often requires high-throughput molecular cloning workflows that are robust and repeatable to increase productivity of target molecules such as nucleotide transcripts, proteins, and metabolites. Traditional screening of transformed bacterial colonies using sterile pipette tips, toothpicks, or inoculation loops are highly prone to human error, labor-intensive, and time-consuming processes that create bottlenecks in your molecular cloning workflows. High throughput synthetic biology applications such as strain engineering will benefit greatly from the increased productivity of a robot-controlled microbial colony picker such as our QPix XE microbial colony picker. The Qpix XE picks up to 30,000 colonies per day with automatic pick run data tracking and database management in a more compact design. The smaller footprint of the QPix XE allows for a higher number of integrated instruments into an end-to-end molecular workflow, which allows users higher throughput and more walkaway time to focus on the learning component of the DBTL approach, which will inform the subsequent design of new strains.

Here we demonstrate that our QPix XE can increase bacterial colony picking efficiency > 10-fold per hour compared to manual picking, greatly reducing FTE hours. The QPix XE maintains a flexible bed design that accommodates various commonly used inputs such as petri dishes, QTrays, and Omnitrays. Our intuitive software allows users to screen and pick from different regions within a segmented QTray or Omnitray as well as perform hit picking and library replications such as liquid-to-liquid, liquid-to-agar, and agar-to-agar replications. The QPix XE is capable of screening microbial colonies in WL and FL, as well as blue/white and zone of inhibition screening with similar applications. The QPix XE can be integrated into large or small automated synthetic biology workcells depending on your end products, throughput and intended amount of walkaway time. These features make it a must have instrument for synthetic biology-focused labs that require high-throughput microbial colony picking in a smaller, more cost-effective package.

Methods

All testing was performed on our QPix 420 AWES and new QPix XE, which are both automation-friendly instruments. Tests were conducted at our lab headquarters located in San Jose, CA, USA, using QTrays.

Comparison of QPix XE vs. QPix 420

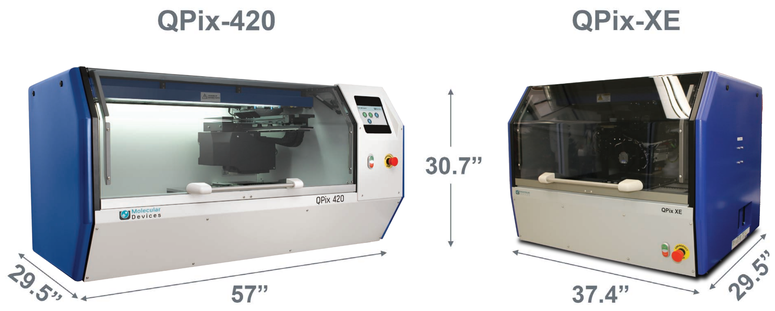

Figure 1. Dimensions of QPix 420 vs. QPix XE. The dimensions of QPix 420 in inches are L 57” x W 29.5” x H 30.7” vs. the QPix XE with L 37.4” x W 29.5” x H 30.7”. The QPix XE is approximately two-third the length of the QPix 420.

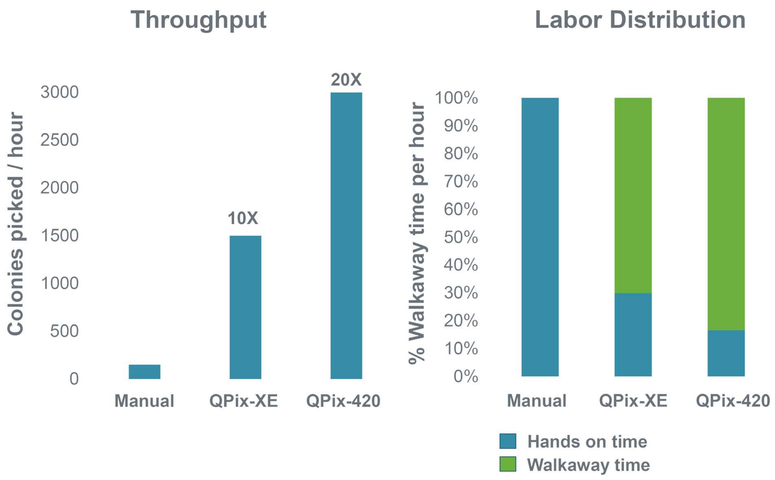

Figure 2. QPix XE has increased throughput and walkaway time compared to a manual screening and picking process. At half the speed of the QPix 420, the QPix XE was 10X more efficient at screening and picking colonies per hour with less hands-on time than a manual screening and picking process.

QPix XE layout and function

Figure 3. Flexible bed design. (Top panel) The QPix XE bed has a left lane that hold four destination plates e.g., 96–384 well plates in standard or deep-well formats using suitable risers shown in red. The middle lane is the imaging bed, which is removable to accommodate more destination lanes depending on the application. The right lane has three wash baths and a halogen lamp the back for pin sterilization. (Bottom panel) The QPix XE bed can accommodate various source plate formats such as Qtrays, Omnitrays, and Petri dishes.

QPix XE layout and function

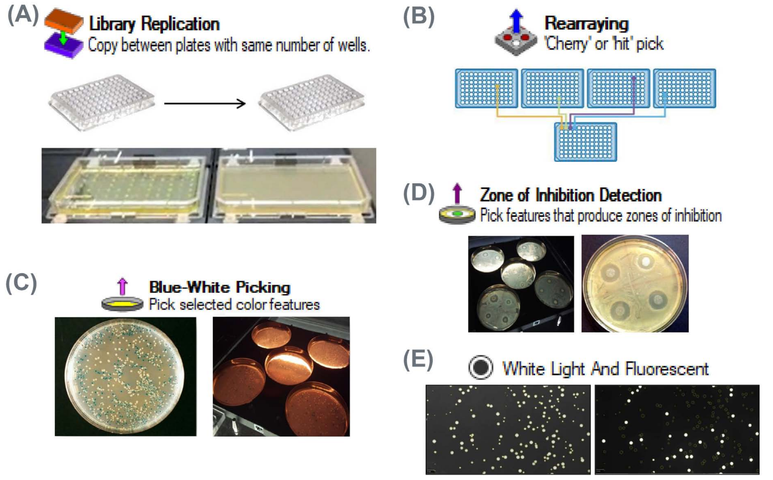

Figure 4. QPix XE applications. The QPix XE is capable of screening microbial colonies in many modalities such as (A) library replications, (B) Hit Picking, (C) Blue-White picking, (D) Zone of inhibition detection, and (E) Fluorescent detection. Other applications not listed can be easily licensed and added to software upon request.

QPix XE automation

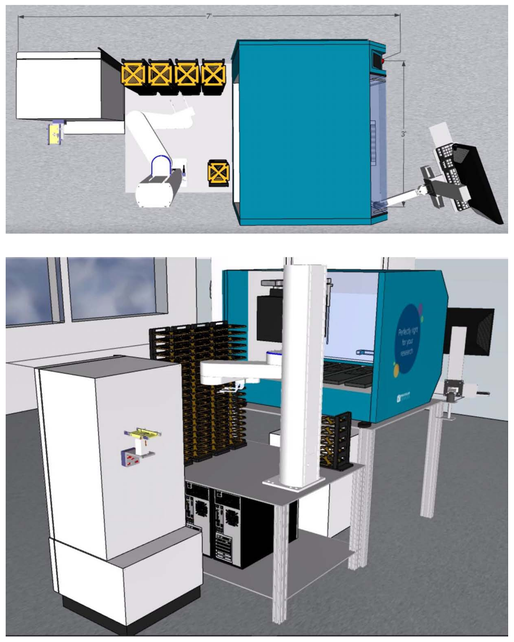

Figure 5. QPix XE function can be automated and integrated into a workcell. (Top panel) The 3D rendering shows a 3 ft x 7 ft automated workcell containing a QPix XE integrated with (top and bottom panel) a robotic arm to bring source and destinations plates into and out of the QPix XE then to an automated incubator or ambient plate storage hotels.

Conclusions and future directions

Inline with the QPix 420 function, the QPix XE provides its customers with a workflow solution for increased throughput and walkaway time in a molecular cloning workflow at almost half the price and 1/3 less the size of the QPix 420. The QPix XE can be incorporated into any automatic platform with ambient plate hotels, robotic arms, automated incubators (shaking and static), liquid handlers, on dec thermocyclers, centrifuges, peelers and sealers, capper/decapper, shakers, heaters, and plate readers for an end-to-end high throughput molecular cloning workflow seen in synthetic biology applications.

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