

# Sanger Tree of Life HMW DNA Extraction: Automated Plant MagAttract v.4

## Authors

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## Abstract

This protocol is for the automated extraction and SPRI of HMW DNA from cryoprepped or bead beaten tissue samples from plants and fungi intended for long-read sequencing using the Qiagen MagAttract HMW DNA extraction kit and the Thermo Fisher KingFisher™ Apex. This process is effective for a wide variety of plant species covered by the Tree of Life Programme. The output of this protocol is HMW DNA, which depending upon yield and genome size of the species, can be directed towards either HMW DNA Pooling, HMW DNA Fragmentation: Diagenode Megaruptor® 3 for LI PacBio or HMW DNA Fragmentation: g-Tube for ULI PacBio. This protocol was adapted from Sanger Tree of Life HMW DNA Extraction: Automated Plant MagAttract v.3 to further improve sample lysis. These improvements have been made through a combination of preheating the lysis buffer, delaying the addition of RNase A to later on in sample lysis and increasing centrifugation of the lysate, which have led to a reduction in tissue clumping, minimised oxidative damage of the DNA, reduced Proteinase K inhibition of RNase A and increased purity of the HMW DNA due to the exclusion of aggregated, insoluble or sedimented contaminants.

## Safety Warnings

- Operator must wear a lab coat, powder-free nitrile gloves and safety specs to perform the laboratory procedures in this protocol. Cotton glove liners are strongly recommended when handling the samples on dry ice.
- Waste needs to be collected in a suitable container (e.g. plastic screw-top jar or Biobin) and disposed of in accordance with local regulations.
- Liquid waste needs to be collected in a suitable container (e.g. glass screw-top jar) and disposed of in accordance with local regulations.
- Do not open the door of the KingFisher™ Apex instrument whilst it is in operation.

## Guidelines:

- For the lysis buffer master mix, prepare enough for n+1 samples to account for pipetting errors.
- Keep samples on dry ice to maintain temperature and prevent nucleic acid degradation until the lysis buffer is ready to be added to them.
- For the 0.45X SPRI, the DNA and AMPure beads should not sit together in the sample plate for more than 5 minutes before starting the KingFisher™ Apex.
- An experienced operator can expect to comfortably process up to 32 samples, with approximately 2-3 hours handling time over a start to finish period of 4-5 hours. This estimation includes the utilisation of the KingFisher™ Apex for both the extraction and SPRI protocols, and excludes subsequent QC checks.

### **Additional Notes:**

- FluidX tubes are used throughout the Tree of Life programme in order to track samples, therefore rather than the microcentrifuge tubes which have been mentioned in this protocol for DNA storage, all routine DNA extracts are stored in FluidX tubes.
- Both the KingFisher™ Apex protocol scripts and the KFX.files have been made available for this protocol - the KFX.files require 'Bindlx software for KingFisher Apex' to allow the KingFisher™ Apex protocols to be viewed on a PC or laptop. Alternatively, the files can be transferred directly onto a KingFisher™ Apex instrument using a USB.

### **Before starting:**

- Add 100% ethanol to the MW1 and PE wash buffers as per manufacturer's instructions.
- AMPure PB beads are stored in the fridge at 4°C – take them out 30 minutes before starting the 0.45X SPRI KingFisher™ Apex protocol to bring them to room temperature.

### **Laboratory Protocol:**

#### **Sample Lysis**

1. Set one heat block with a 50 mL SmartBlock to 65 °C and another heat block with a 2 mL SmartBlock to 55 °C.
2. Prepare a lysis buffer master mix in a 50 mL centrifuge tube:

<b>Reagent</b>	<b>Volume per sample</b>
Phosphate buffered saline (PBS)	200 µL
Buffer AL	150 µL

3. Place the lysis buffer on the 65 °C heat block and incubate at 400 rpm for at least 20 minutes. Keep at temperature until added to the sample.
4. Transfer 50 mg of cryogenically disrupted tissue from each sample to 2 mL microcentrifuge tubes.
  - Ensure the disrupted tissue is completely disrupted into a fine powder; avoid matted/clumped powder. This is crucial for optimal DNA yield and integrity; poorly disrupted tissue drastically decreases lysis and extraction efficiency.
  - Any samples containing poorly disrupted tissue 'chunks' should be flagged as requiring reprocessing and further cryogenically disrupted.
5. Transfer the samples to a pre-chilled cold block on wet ice and incubate for 10 minutes to equilibrate temperature.

6. Add 20  $\mu\text{L}$  Proteinase K (for n+1 samples) to the preheated lysis buffer immediately prior to initiating lysis, swirling the centrifuge tube to mix.
7. Add 370  $\mu\text{L}$  of the preheated lysis buffer plus Proteinase K to each sample, immediately homogenising the lysate by mixing with 5 rapid pulse vortexes, and place on the 55  $^{\circ}\text{C}$  heat block at 600 rpm for 15 minutes.
8. After 5 minutes incubation, resuspend any severely aggregated samples by pipette mixing with a wide bore pipette tip.
9. After the initial 15 minute incubation, add 4  $\mu\text{L}$  RNase A to each sample and mix thoroughly by inversion until any aggregated, insoluble or sedimented tissue particles are resuspended.
10. Incubate samples for a further 45 minutes on the heat block at 55  $^{\circ}\text{C}$  at 600 rpm.
11. During this incubation, samples should be occasionally mixed (every 5-15 minutes) by inversion to resuspend sedimented particles.  
Do not mix the samples by inversion for the final 15 minutes of lysis, allowing aggregated, insoluble or sedimented tissue particles to settle at the bottom of the tube.

### **Loading and Running the KingFisher™ Apex for DNA Extraction**

12. Whilst samples lyse, label nine 1 mL 96-well deep-well KingFisher™ plates and fill the number of wells required for the number of samples in each plate as follows:

<b>Plate</b>	<b>Reagent(s) required</b>
Tip plate	96-well tip comb (no reagent)
Elution 2	200 $\mu\text{L}$ Buffer AE
Elution 1	200 $\mu\text{L}$ Buffer AE
NFW Wash	500 $\mu\text{L}$ Nuclease-Free Water
PE Wash 2	700 $\mu\text{L}$ Buffer PE
PE Wash 1	700 $\mu\text{L}$ Buffer PE
MW1 Wash 2	700 $\mu\text{L}$ Buffer MW1
MW1 Wash 1	700 $\mu\text{L}$ Buffer MW1
Sample plate	15 $\mu\text{L}$ Suspension G magnetic beads + 280 $\mu\text{L}$ Buffer MB

13. Once samples have completed lysing, remove sample tubes from the heat block and allow the lysate to settle to the bottom of the tube for 5 minutes.
14. Centrifuge the samples for 10 minutes, 8000 x *rpm* at room temperature.
15. Using a wide bore pipette tip, set the volume to 380  $\mu$ L, gently transfer lysate from the sample tubes to individual wells in the sample plate, taking care to avoid aspirating the pelleted tissue particles.
16. Select the required DNA extraction protocol in the protocol list on the KingFisher™ Apex (details below in KingFisher™ Apex DNA Extraction Protocol section/attached file) and select using the play button.
17. Load the filled plates onto the instrument following the instructions provided on screen.
18. Prior to loading the “Sample Plate”, the instrument will prompt to remove the “Tip Plate”. Once the final plate is loaded, the protocol will automatically begin; this takes approximately 50 minutes.
19. Once the protocol has completed, follow the on-screen instructions to remove plates from the instrument.
20. Inspect the elution plates for any magnetic beads in the wells. In the rare instance of magnetic beads remaining in the eluate (possible in viscous samples), these samples will need to be transferred to a 1.5 mL microcentrifuge tube and placed on a magnetic rack. Allow around 5 minutes for the beads to migrate and take the clear eluate containing the DNA using a wide bore pipette tip.
21. Using a 200  $\mu$ L multi-channel pipette and wide bore tips, pipette eluates from Elution Plate 2 into Elution Plate 1, and gently pipette mix 5-10 times with wide bore tips to fully homogenise DNA in the eluate. Elution Plate 1 with the combined eluates is now the ‘Sample Plate’ for the 0.45X SPRI.

**Loading and Running the KingFisher™ Apex for the 0.45X SPRI**

22. Set-up the KingFisher plates for the 0.45X SPRI as detailed below:

Plate	Plate Type	Reagent(s) required
Tip Plate	1 mL Deep-well	96-well tip comb (no reagent)
Sample Plate (Elution Plate 1 from DNA	1 mL Deep-well	380 $\mu$ L DNA +

Extraction Protocol)		171 µL AMPure PB beads
Ethanol Wash Plate	1 mL Deep-well	1000 µL 80% EtOH (freshly made)
Elution Plate	200 µL standard	135 µL Buffer EB

23. Select the required 0.45X SPRI protocol in the protocol list on the KingFisher™ Apex (details below in KingFisher™ Apex 0.45X SPRI Protocol section/attached file) and select using the play button.
24. Load the filled plates onto the instrument following the instructions provided on screen.
25. Once the final plate is loaded, the protocol will automatically begin; this will take approximately 40 minutes.
26. Once the protocol has completed, follow the on-screen instructions to remove plates from the instrument.
27. Using a wide bore pipette tip, transfer the 130 µL of eluate from the elution plate into microcentrifuge tubes.
28. Incubate the DNA at room temperature overnight and perform the required QC the following morning.
29. Store the DNA at 4 °C.

### KingFisher™ Apex DNA Extraction Protocol:

- 1) Pick Up Tip - Tip Plate
- 2) DNA Binding - Sample Plate
  - Pre-collect beads: Off
  - Release beads: Off
  - Heating & Cooling: Off
  - Mixing 1# 00:05:00 Fast
  - Postmix: Off
  - Collect beads: On 5 Count 2 Seconds
- 3) Collect Beads 1 - Sample Plate
  - Collect beads: Count 5 Collect time 1 Second
- 4) Wash 1 - MW1 Wash 1 Plate
  - Pre-collect beads: Off
  - Release beads: On 00:00:10 Bottom mix
  - Heating & Cooling: Off
  - Mixing 1# 00:01:00 Fast

- Postmix: Off
- Collect beads: On 5 Count 1 Second
- 5) Collect Beads 2 - MW1 Wash 1 Plate
- Collect beads: Count 5 Collect time: 1 Second
- 6) Wash 2 - MW1 Wash 2 Plate
- Pre-collect beads: Off
- Release beads: On 00:00:10 Bottom mix
- Heating & Cooling: Off
- Mixing 1# 00:01:00 Fast
- Postmix: Off
- Collect beads: On 5 Count 1 Second
- 7) Collect Beads 3 - MW1 Wash 2 Plate
- Collect beads: Count 5 Collect time: 1 Second
- 8) Wash 3 - PE Wash 1 Plate
- Pre-collect beads: Off
- Release beads: On 00:00:10 Bottom mix
- Heating & Cooling: Off
- Mixing 1# 00:01:00 Fast
- Postmix: Off
- Collect beads: On 5 Count 1 Second
- 9) Collect Bead 4 - PE Wash 1 Plate
- Collect beads: Count 5 Collect time: 1 Second
- 10) Wash 4 - PE Wash 2 Plate
- Pre-collect beads: Off
- Release beads: On 00:00:10 Bottom mix
- Heating & Cooling: Off
- Mixing 1# 00:01:00 Fast
- Postmix: Off
- Collect beads: On 5 Count 1 Second
- 11) Collect Bead 5 - PE Wash 2 Plate
- Collect beads: Count 5 Collect time 1 Second
- 12) Water Rinse - NFW Plate
- Pre-collect beads: Off
- Release beads: Off
- Heating & Cooling: Off
- Mixing 1# 00:00:00
- Postmix: Off
- Collect beads: On 5 Count 1 Second
- 13) Dry - NFW Plate
- Duration: 00:01:00 Dry Type: Above Well
- 14) Elute 1 - Elution Plate 1 Plate
- Pre-collect beads: Off
- Release beads: On 00:00:00
- Heating & Cooling: On 25°C Pre-heat: Off
- Mixing 1# 00:01:00 Paused Looping: 1
- 2# 00:05:00 Slow Tip Position: Above Well
- Postmix: Off
- Collect beads: On 3 Count 1 Seconds

15) Elute 2 - Elution Plate 2 Plate

Pre-collect beads: Off  
Release beads: On 00:00:00  
Heating & Cooling: On 25°C Pre-heat: Off  
Mixing 1# 00:01:00 Paused Looping: 1  
2# 00:05:00 Slow Tip Position: Above Well  
Postmix: Off  
Collect beads: On 3 Count 1 Seconds

16) Leave Tip - NFW Plate

**KingFisher™ Apex 0.45X SPRI Protocol:**

1) Pick Up Tip - Tip Plate

2) Mix - Sample Plate

Pre-collect beads: Off  
Release beads: On 00:00:00  
Heating & Cooling: Off  
Mixing:  
1# 00:01:00 Slow  
2# 00:01:00 Medium  
3# 00:08:00 Paused  
Looping: 1 Tip position: Tip edge in liquid  
Postmix: Off  
Collect beads: On 10 Count 30 Seconds

3) Wash 1 - Ethanol Wash Plate

Pre-collect beads: On  
Release beads: Off  
Heating & Cooling: Off  
Mixing 1# 00:00:30 Slow  
Postmix: Off  
Collect beads: Off

4) Wash 2 - Ethanol Wash Plate

Pre-collect beads: Off  
Release beads: Off  
Heating & Cooling: Off  
Mixing 1# 00:00:30 Slow  
Postmix: Off  
Collect beads: Off

5) Dry - Ethanol Wash Plate

Duration: 00:01:00 Above well

6) Elute - Elution Plate

Pre-collect beads: Off  
Release beads: On 00:01:00 Slow  
Heating & Cooling: On 37°C Preheat: On  
Mixing: 1# 00:07:00 Slow  
2# 00:08:00 Paused  
Looping: 1 Tip position: Tip edge in liquid  
Postmix: Off  
Collect beads: On 4 Count 30 Seconds

## 7) Leave Tip - Ethanol Wash Plate

### Materials:

- 1.5 mL DNA Lo-Bind microcentrifuge tubes (Eppendorf Cat. no. 0030108051)
- 2 mL DNA Lo-Bind microcentrifuge tubes (Eppendorf Cat. no. 0030108078)
- Thermo Fisher KingFisher™ 96-well Deep-well plates (Thermo Fisher Cat. no. 95040450)
- Thermo Fisher KingFisher™ 200 µL standard 96-well Plate (Thermo Fisher Cat. no. 97002084)
- Thermo Fisher KingFisher™ 96 Tip Comb (Thermo Fisher Cat. no. 97002570)
- Qiagen MagAttract HMW DNA extraction kit (Qiagen Cat. no. 67563)
- Dry ice
- 1x phosphate-buffered saline (PBS)
- 100% absolute ethanol
- 15 mL or 50 mL centrifuge tubes
- AMPure PB beads (Pacific Biosciences Cat. no. 100-265-900)
- Buffer EB (Qiagen Cat. no. 19086)

### Equipment:

- Pipettes for 0.5 - 1000 µL and filtered tips
- Wide bore tips (200 µL and 1000 µL, filtered if available)
- Thermo Fisher KingFisher™ Apex instrument (Cat. no. 5400930)
- Eppendorf ThermoMixer C (Cat. no. 5382000031)
- Eppendorf SmartBlock 2.0 mL (Cat no. 5362000035)
- Eppendorf SmartBlock 50 mL (Cat no. 5365000028)
- Vortexer (Vortex Genie™ 2 SI-0266)
- Mini centrifuge (Cat. no. SS-6050)
- Eppendorf™ Centrifuge 5425/5425 R (Cat. no. 5405000263)
- DynaMag™-2 magnetic rack (Cat. no. 12321D)
- Timer

### References:

MagAttract HMW DNA Handbook: [MagAttract HMW DNA Handbook - QIAGEN](#)

[Procedure & checklist - Preparing whole genome and metagenome libraries using SMRTbell prep kit 3.0 \(pacb.com\)](#)