Synthesis of a limonoid, azadiradione

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1) Name the starting material. *trans,trans*-Farnesol.
2) Hint: product has a phosphorous NMR shift around 140 ppm.
3) Hint: nitromethane is a solvent. A tricyclic system is formed.
4) Hint: oxidative demercuration. Can you propose a mechanism? See below.
5) Name of reagent? Jones reagent

6) NaH, P(OEt)₂Cl (1 eq.)
7) ethylene glycol, PTSA
8) DIBAL
9) HO₂SONO
10) sunlamp, 50 °C
11) 1M HCl
12) \( \text{N(CH}_3\text{)}_2\text{BH(OAc)}_3 \), -78 °C
13) 2, EtOH, reflux then 12M HCl, 10 °C
14) NaOEt, EtOH, 70 °C
15) BrCH\(_2\)OCH\(_3\), TBAI, DIPEA, 70 °C

16) L-selectride (excess)
17) BzOH, DEAD, PPh\(_3\) then NaOH, EtOH
18) Zn/Ag, CH\(_2\)\(_2\) then substrate, 0 °C
19) DMP
20) Li, NH\(_3\), THF then DMP
21) LDA, PhSeBr then 30% H\(_2\)O\(_2\) in H\(_2\)O/pyridine
22) TMSBr, DCM
23) Ac\(_2\)O, DMAP

11) Hint: a hemiacetal is formed. Can you rationalize its diastereoselectivity? see below
12) Hint: selective hemiacetal reduction.
13) Name the two reactions occurring in this step. How would you prepare 2? Michael and Nef reactions. 2 can be prepared through condensation of furan-3-carboxaldehyde and nitromethane followed by reduction with NaBH\(_4\).

17) Hint: selective reaction at C16 (according to IUPAC atom numbering for steroids). Name the reaction. Mitsunobu.
18) Name the reaction. Simmons-Smith reaction.