Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting Information

Highly efficient green synthesis of α-hydroxyphosphonates using recyclable choline hydroxide catalyst

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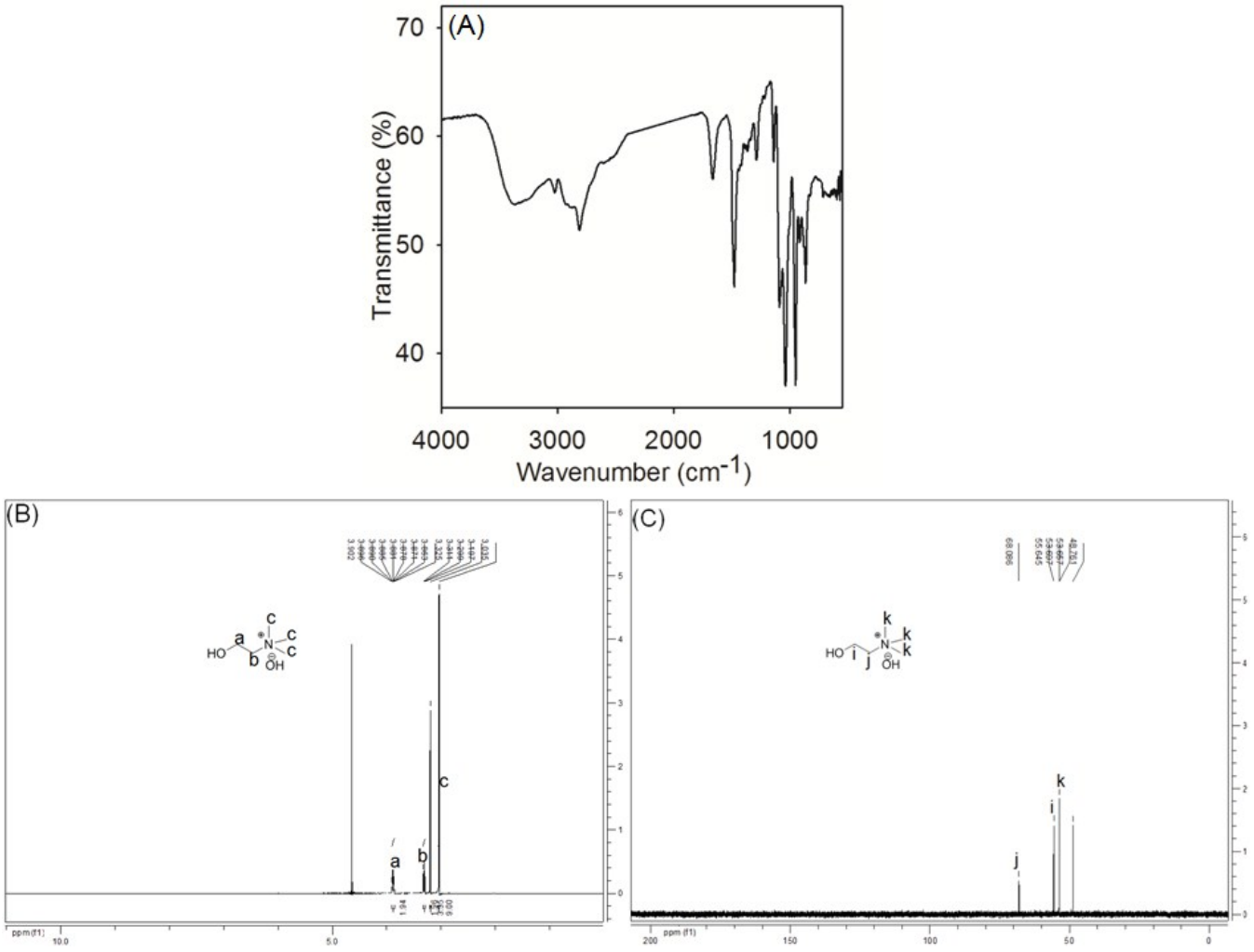


Fig. S1. FT-IR (A), ^{1}H NMR (B), and ^{13}C NMR (C) spectra of ChOH**.**

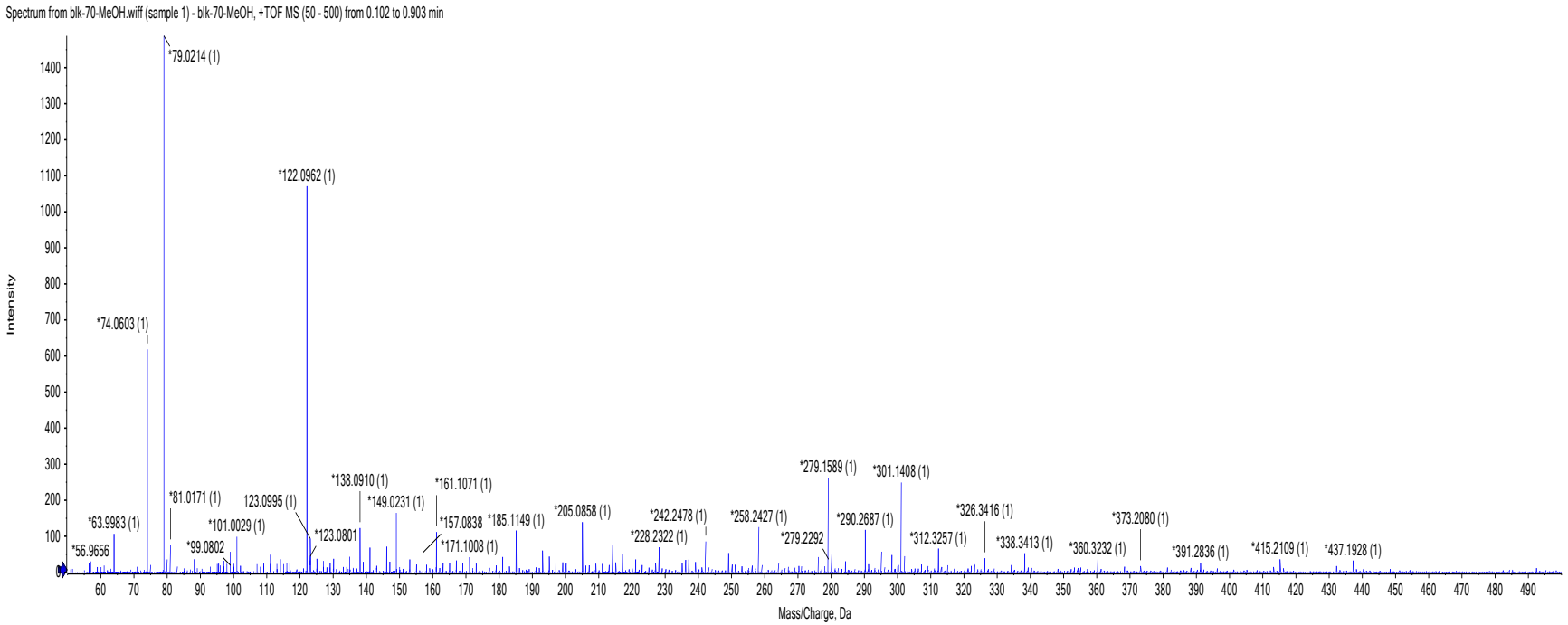
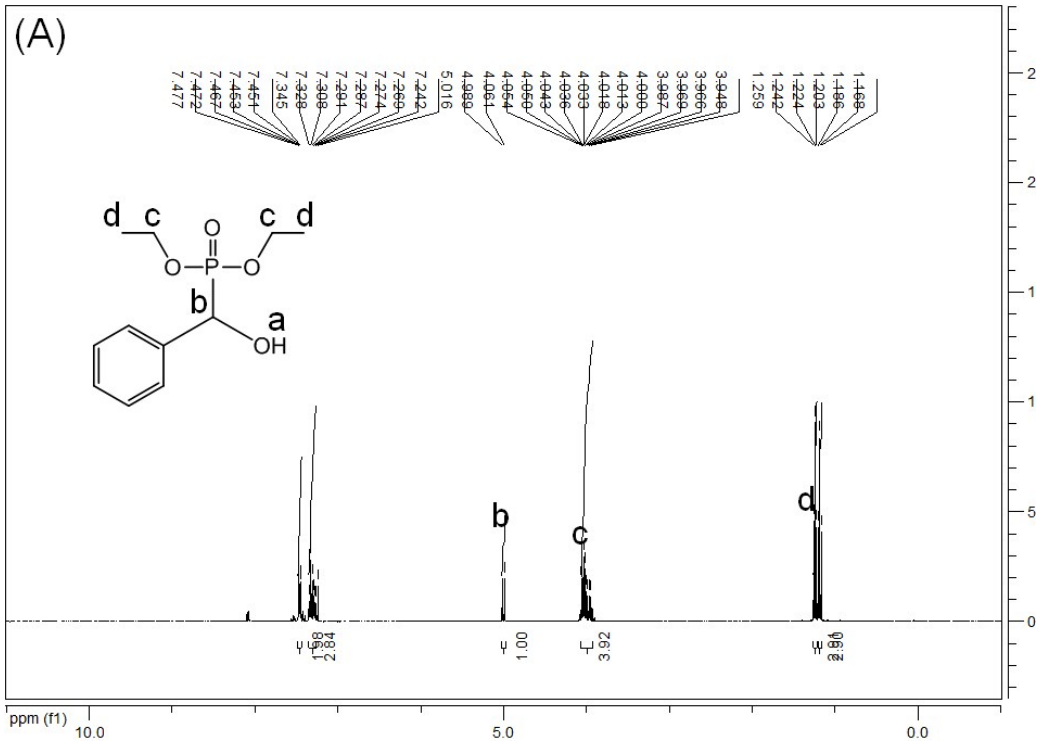
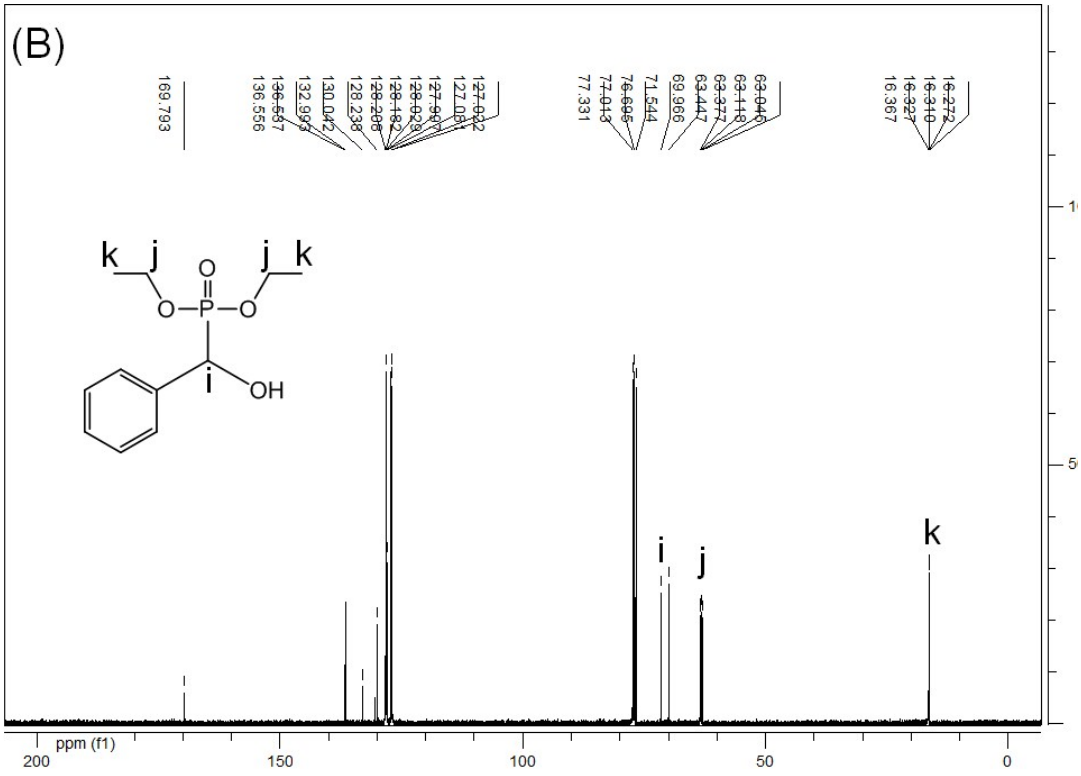


Fig. S2. Mass spectrum of ChOH**.**

2. ^{1}H, ^{13}C, and ^{31}P NMR spectra for the HPPs





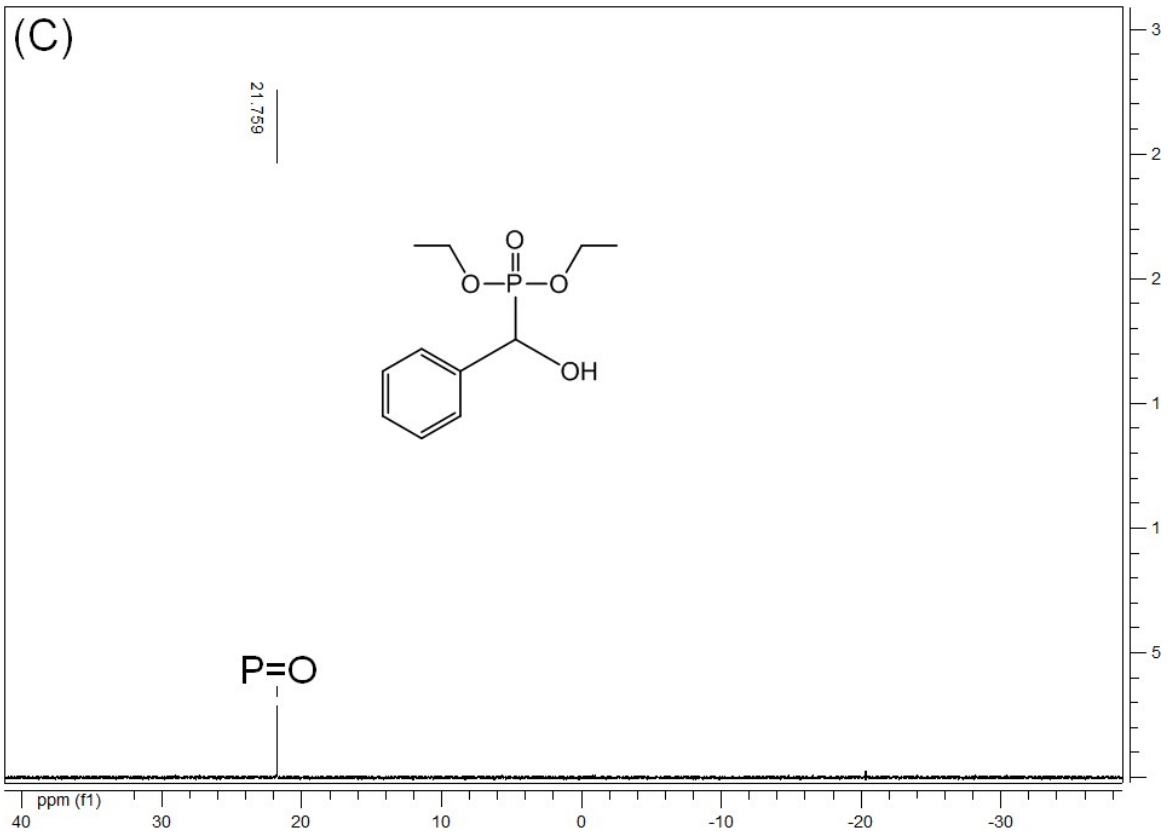
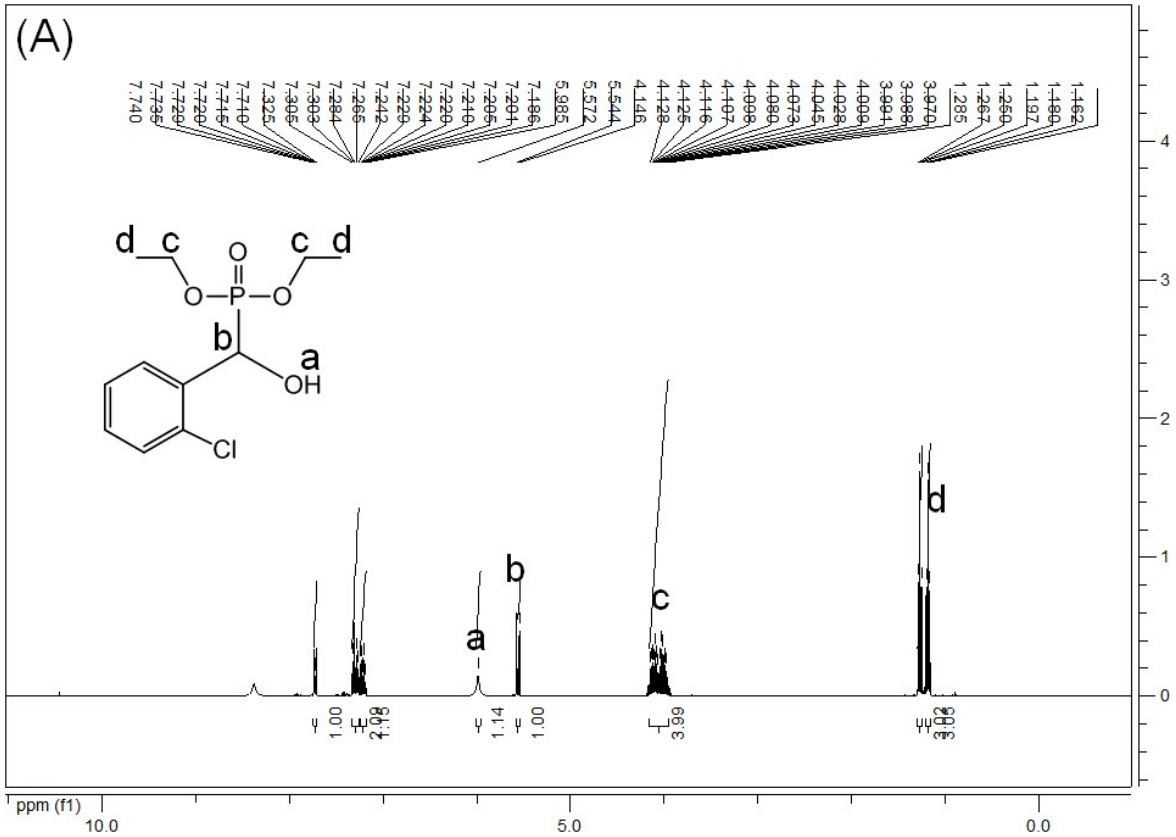


Fig. S3. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **1.**



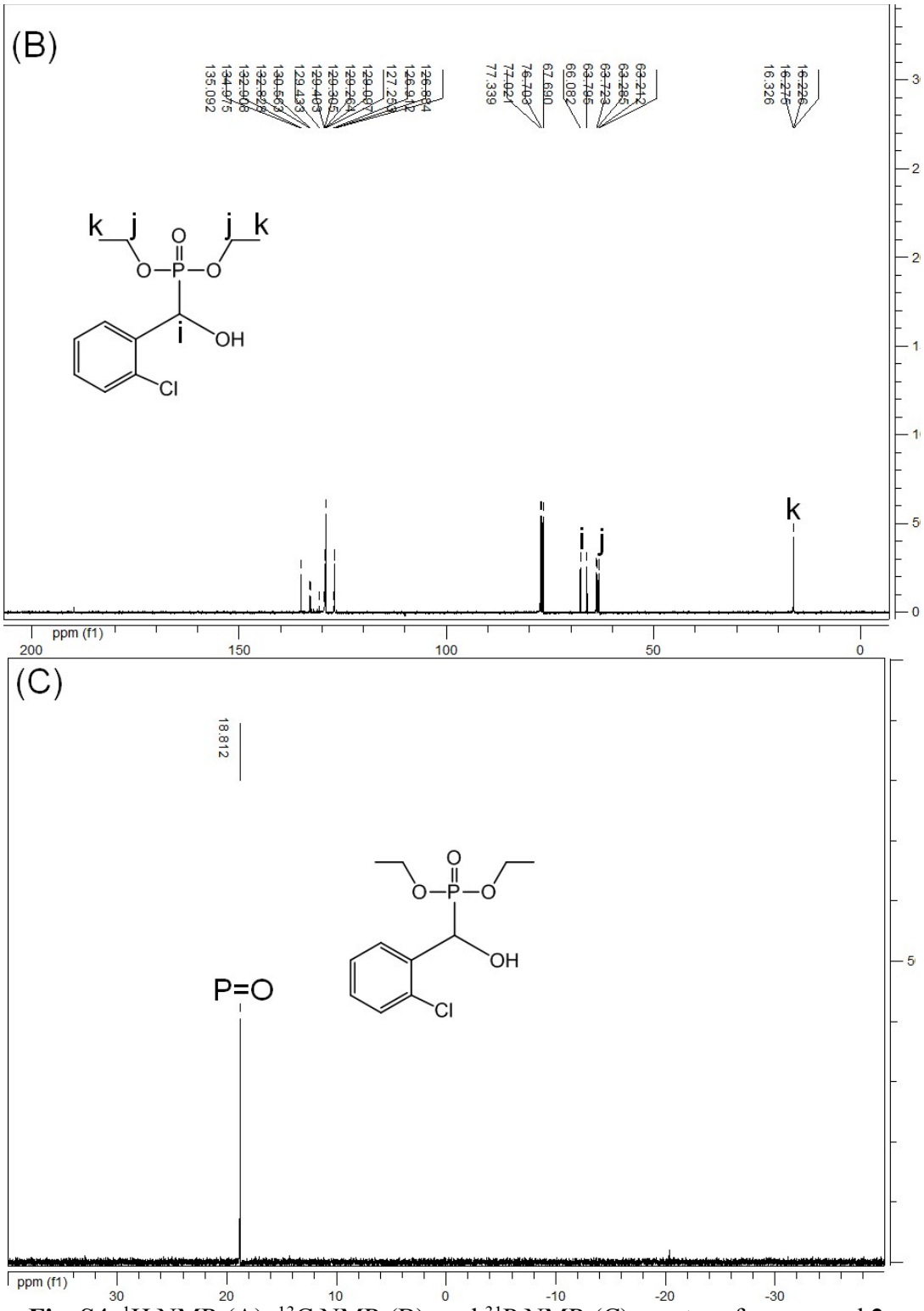
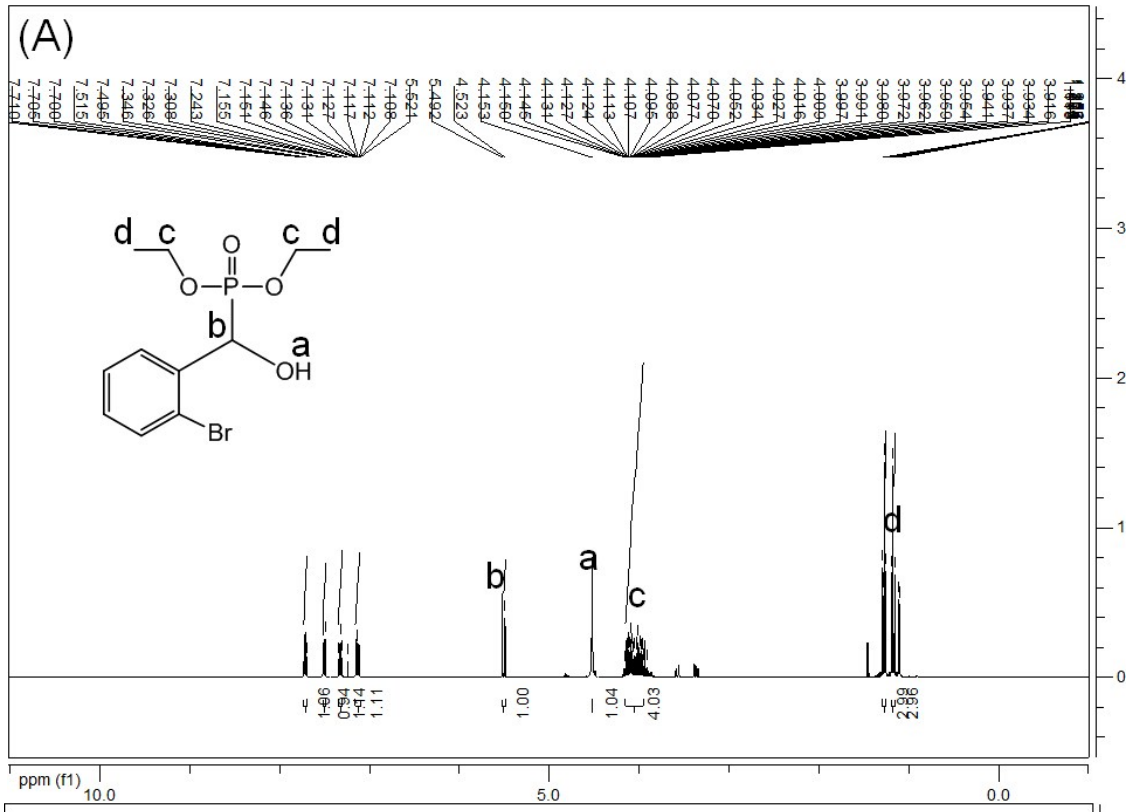
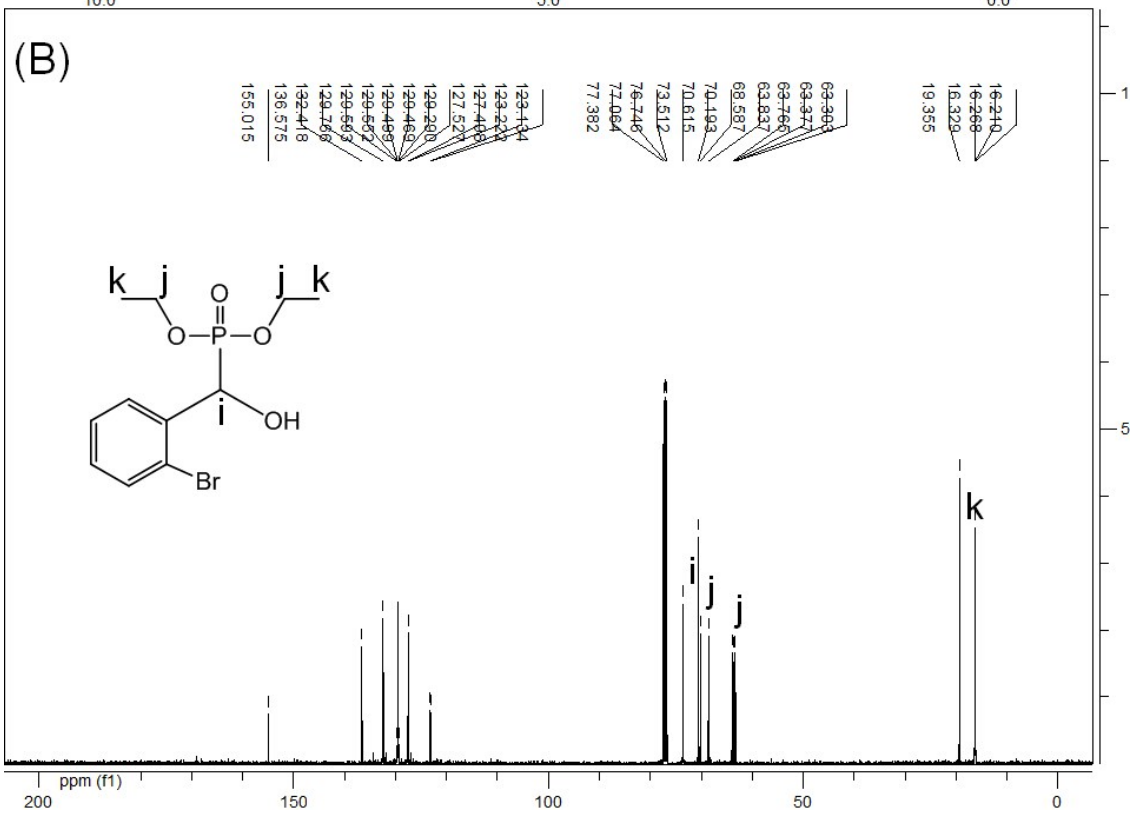


Fig. S4. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **2.**


(A)
d c
c d
O
O P O
b
a
OH
Br
b
a
c
d
ppm (f1)
10.0
5.0
0.0


(B)
k j
j k
O
O P O
i
OH
Br
k
i
j
j
ppm (f1)
200
150
100
50
0

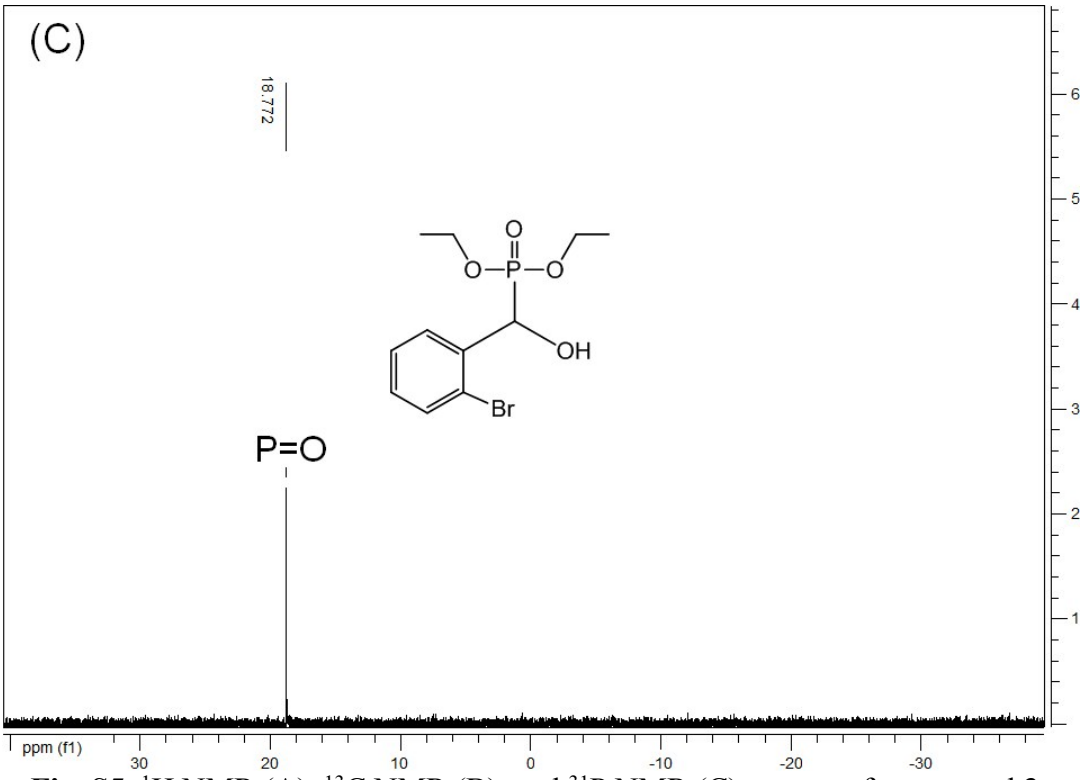
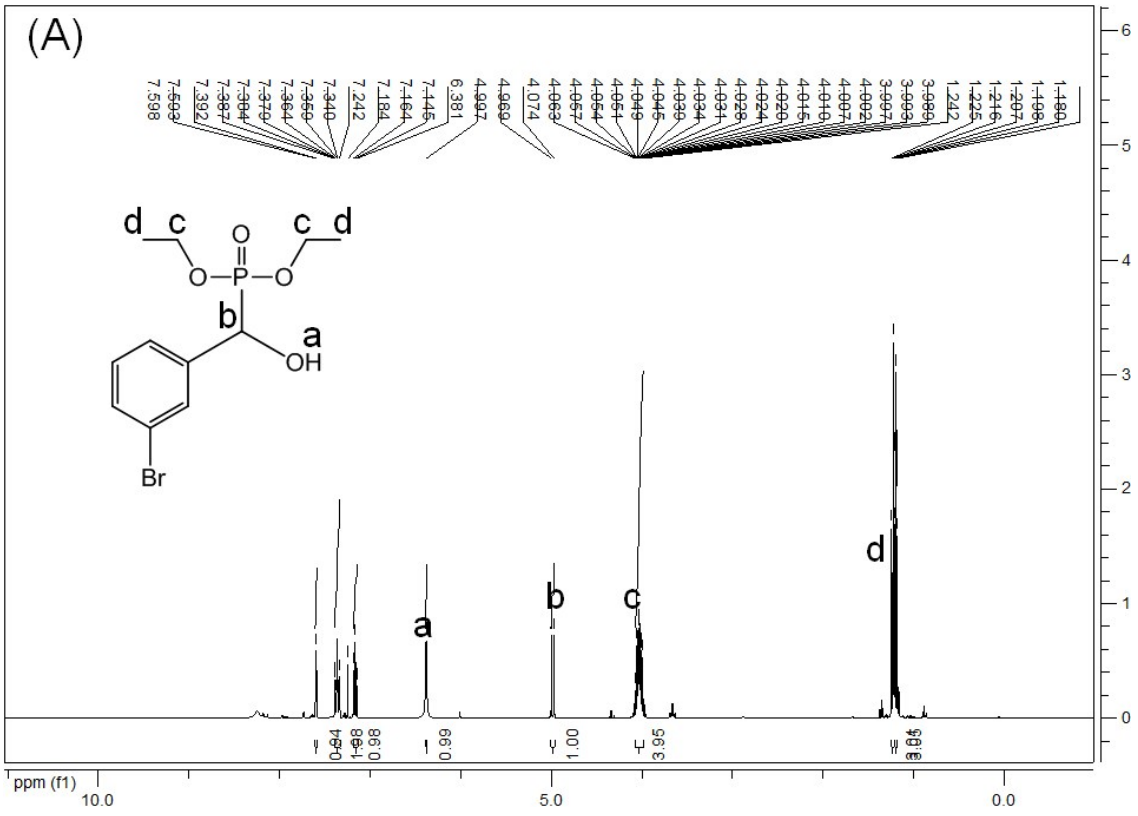


Fig. S5. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **3.**



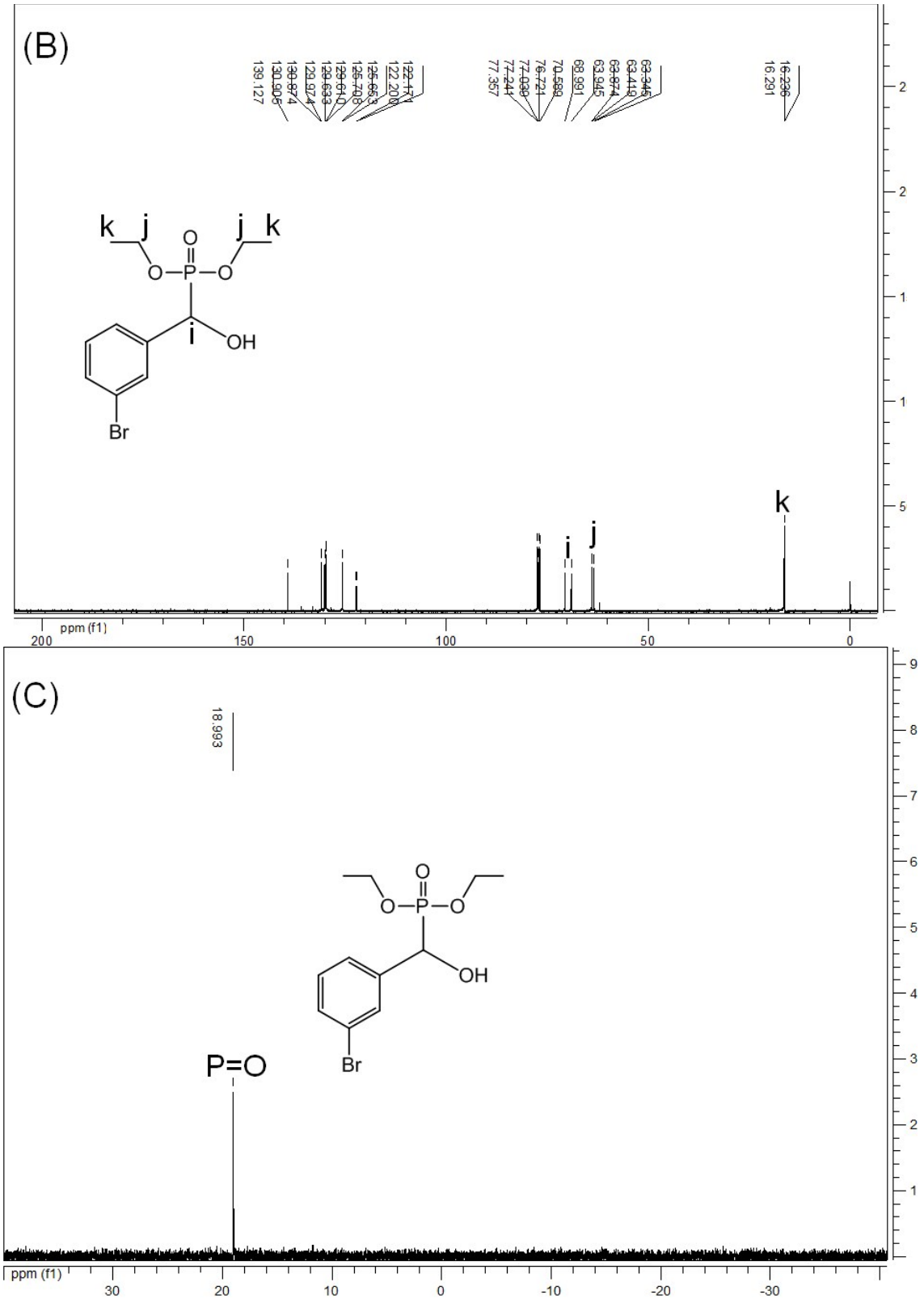
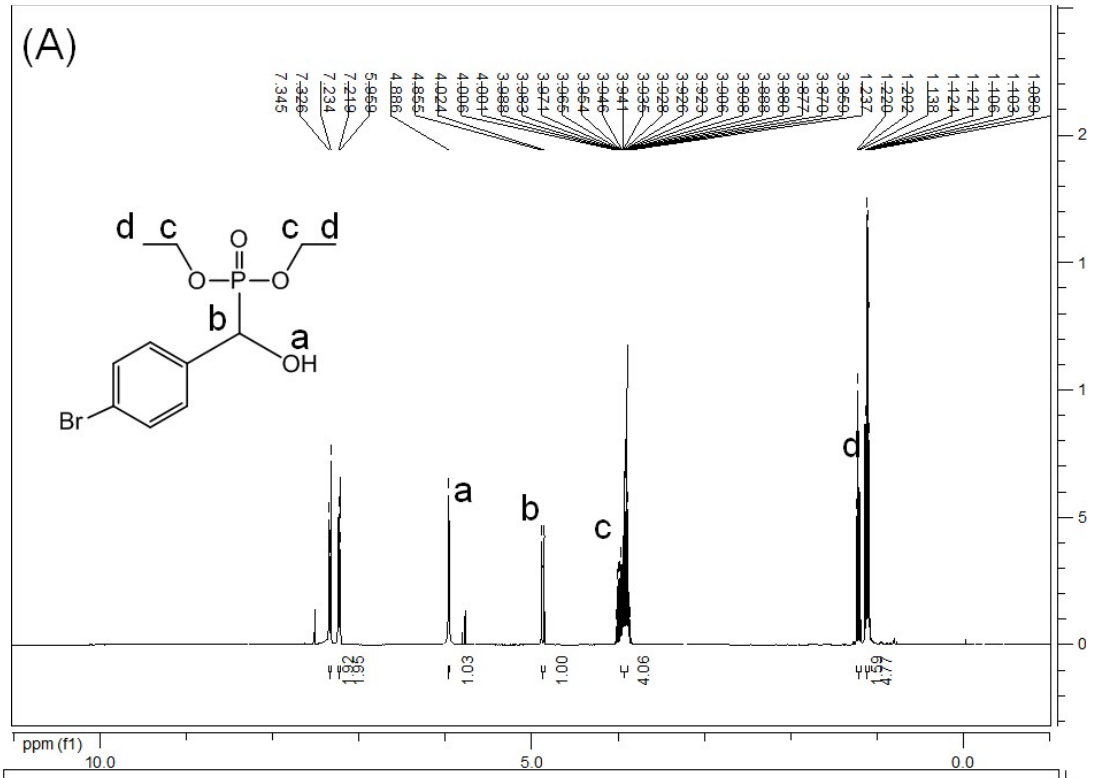
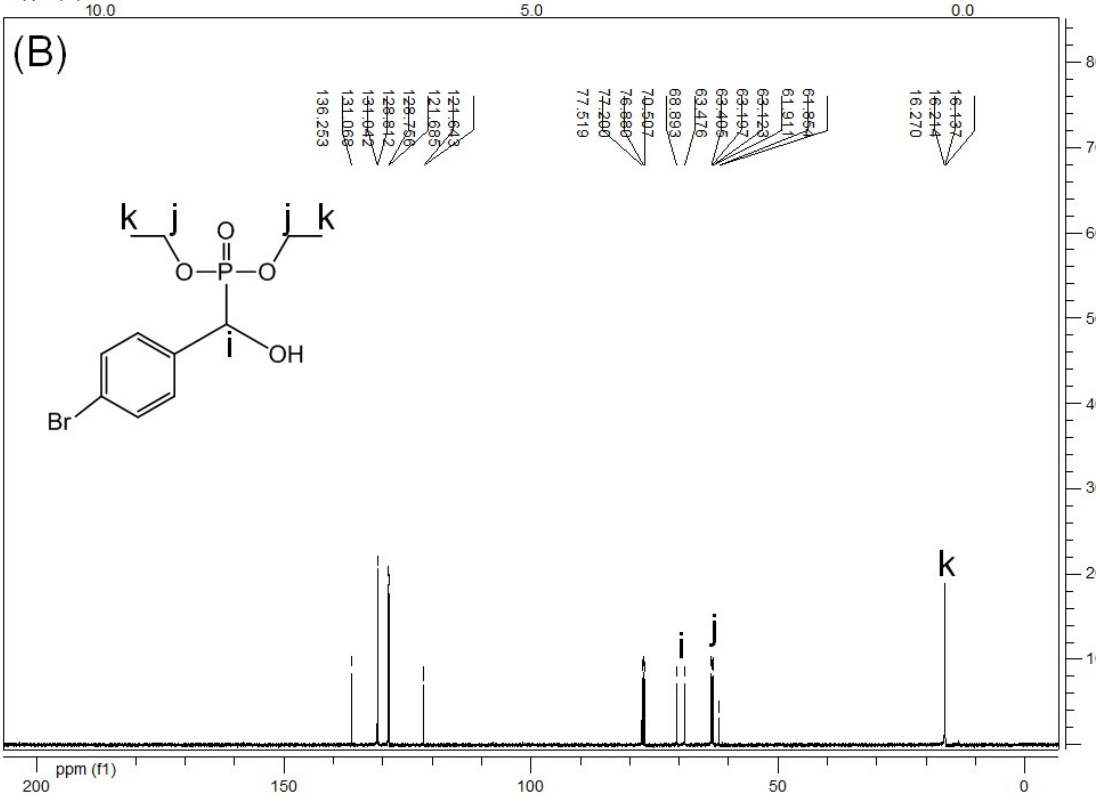


Fig. S6. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **4.**


(A)
d c
c d
O
O–P–O
b
a
OH
Br
a
b
c
d
ppm (f1)
10.0
5.0
0.0


(B)
k j
j k
O
O–P–O
i
OH
Br
k
i
j
ppm (f1)
200
150
100
50
0

X

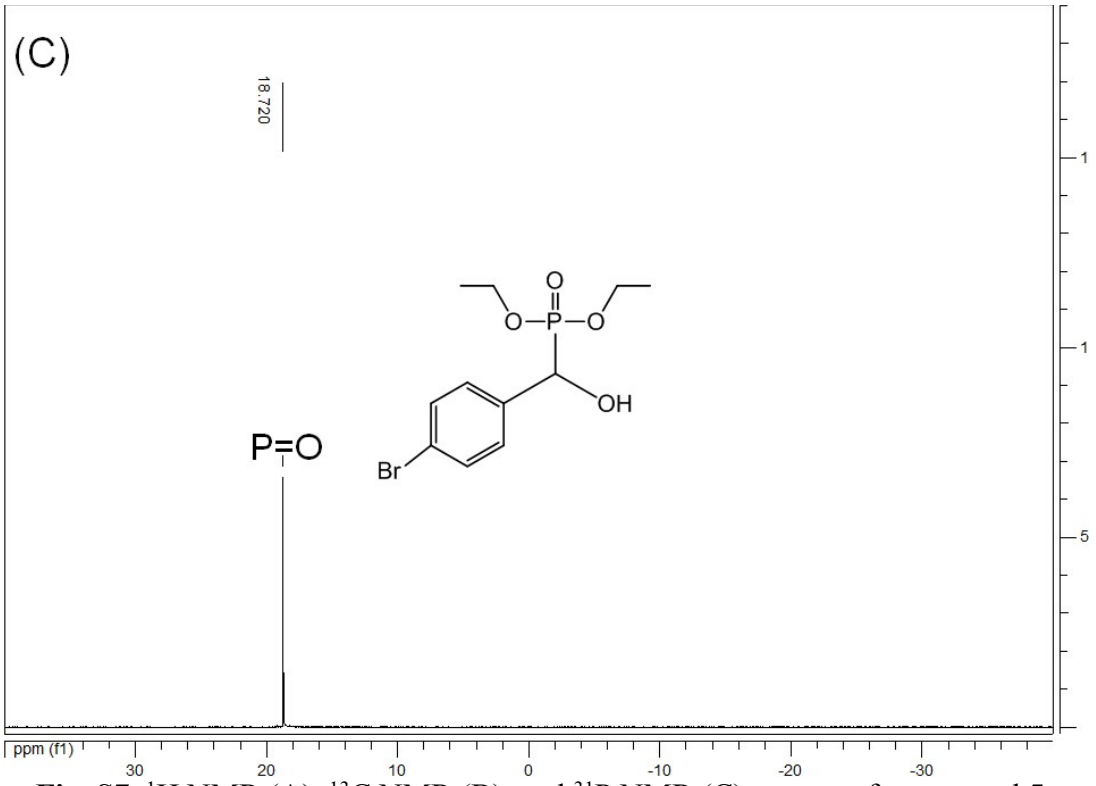
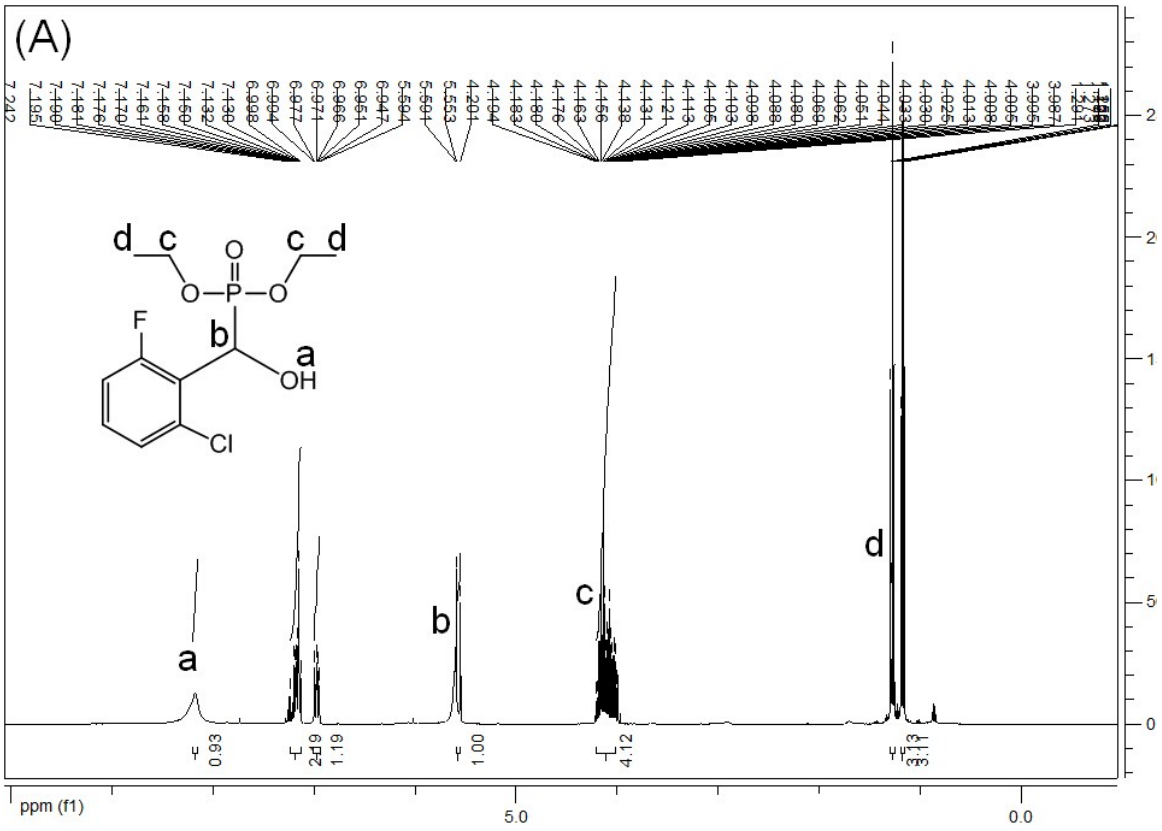


Fig. S7. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **5.**



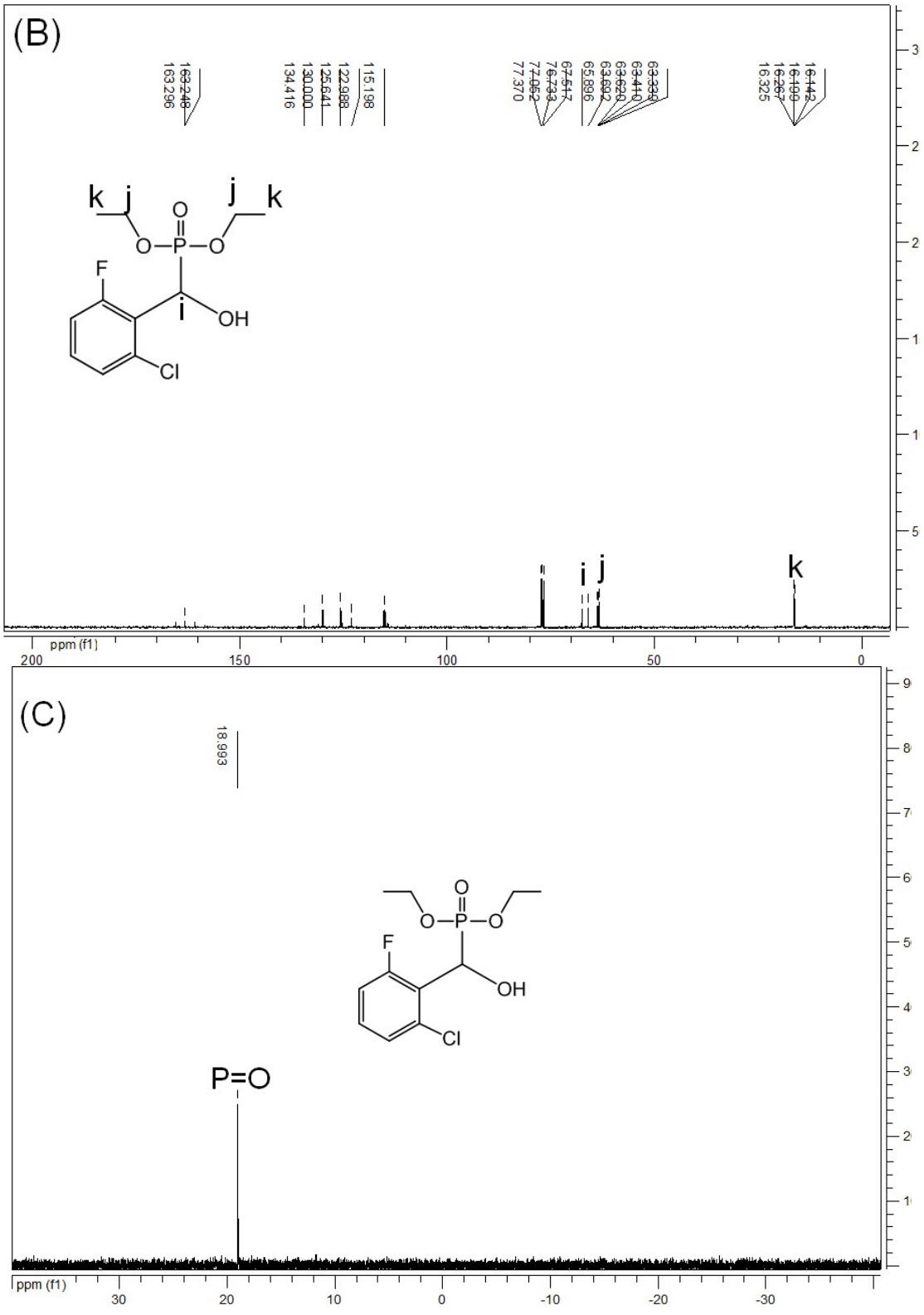
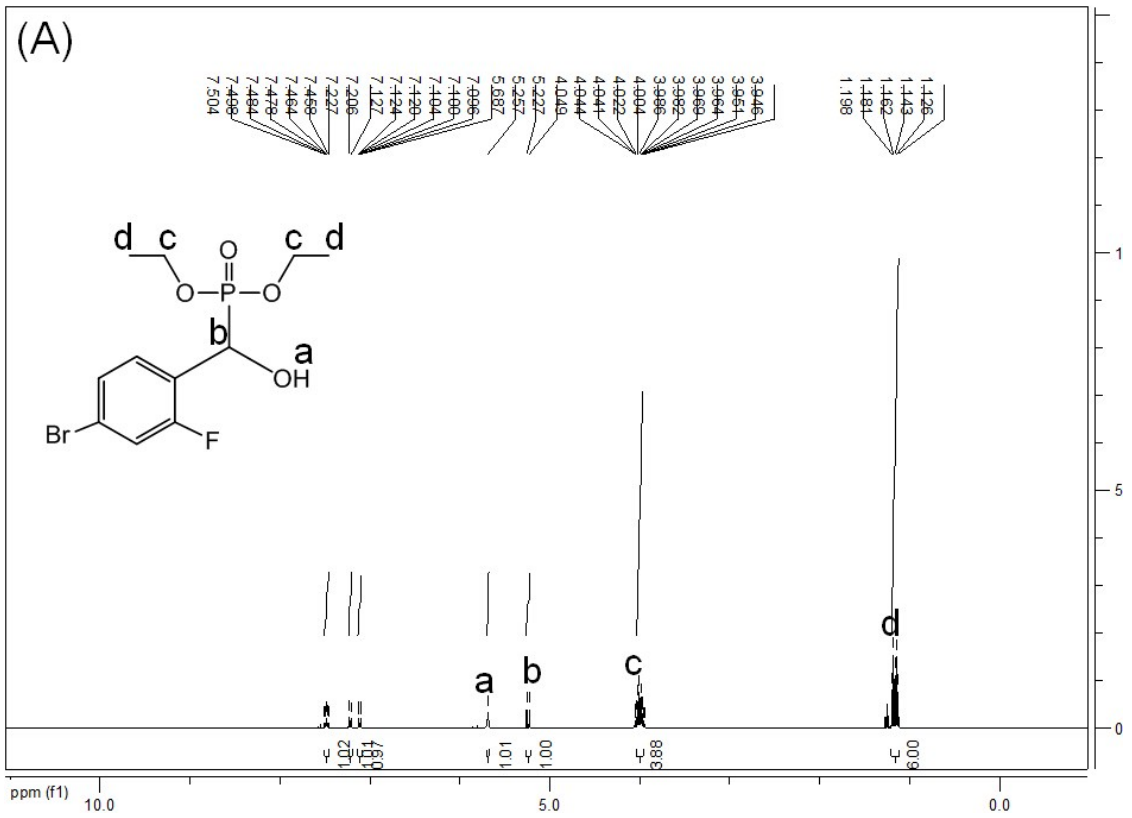
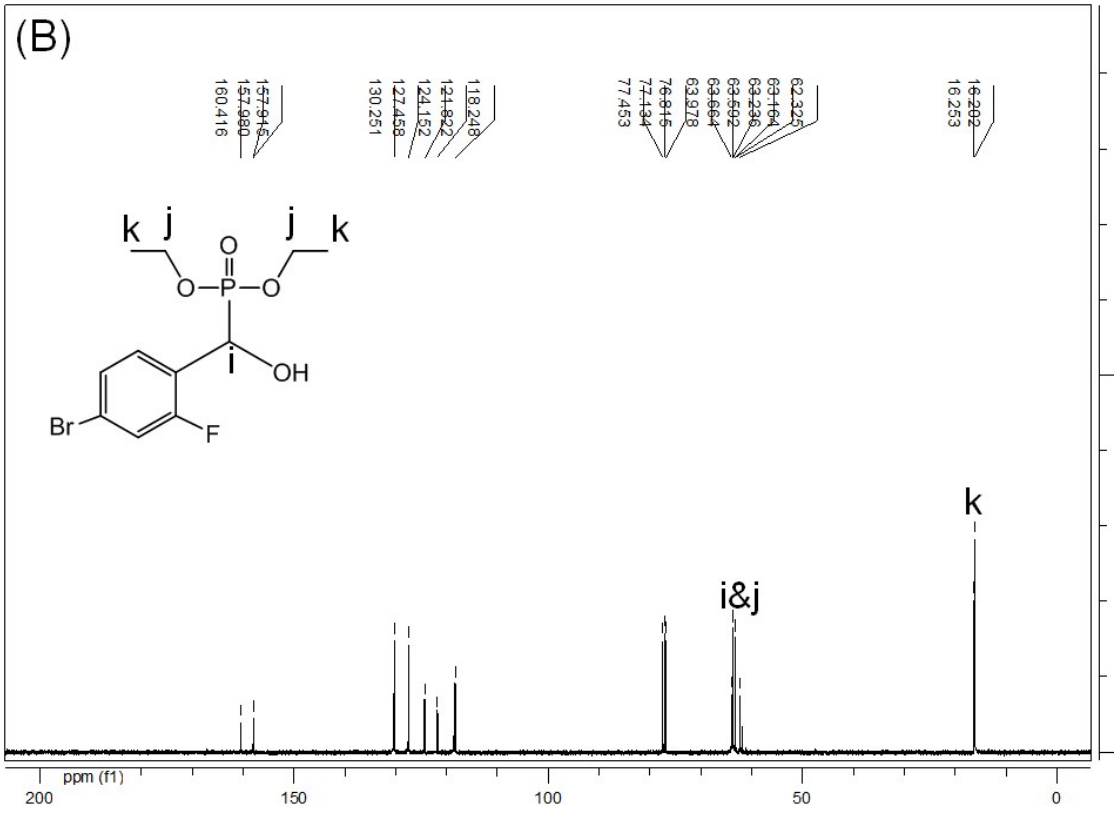


Fig. S8. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **6.**


(A)
d c
c d
O
O–P–O
b
a
OH
Br
F
a
b
c
d
ppm (f1)
10.0
5.0
0.0


(B)
k j
j k
O
O–P–O
i
OH
Br
F
k
i&j
ppm (f1)
200
150
100
50
0

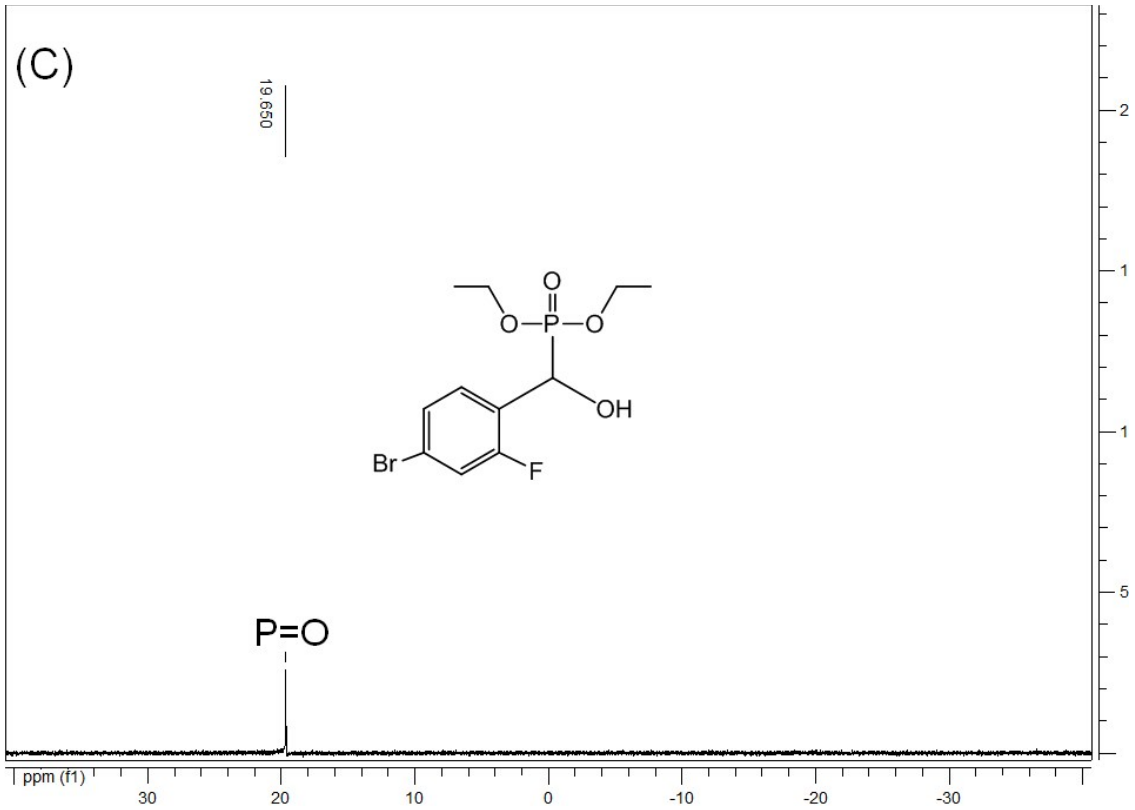
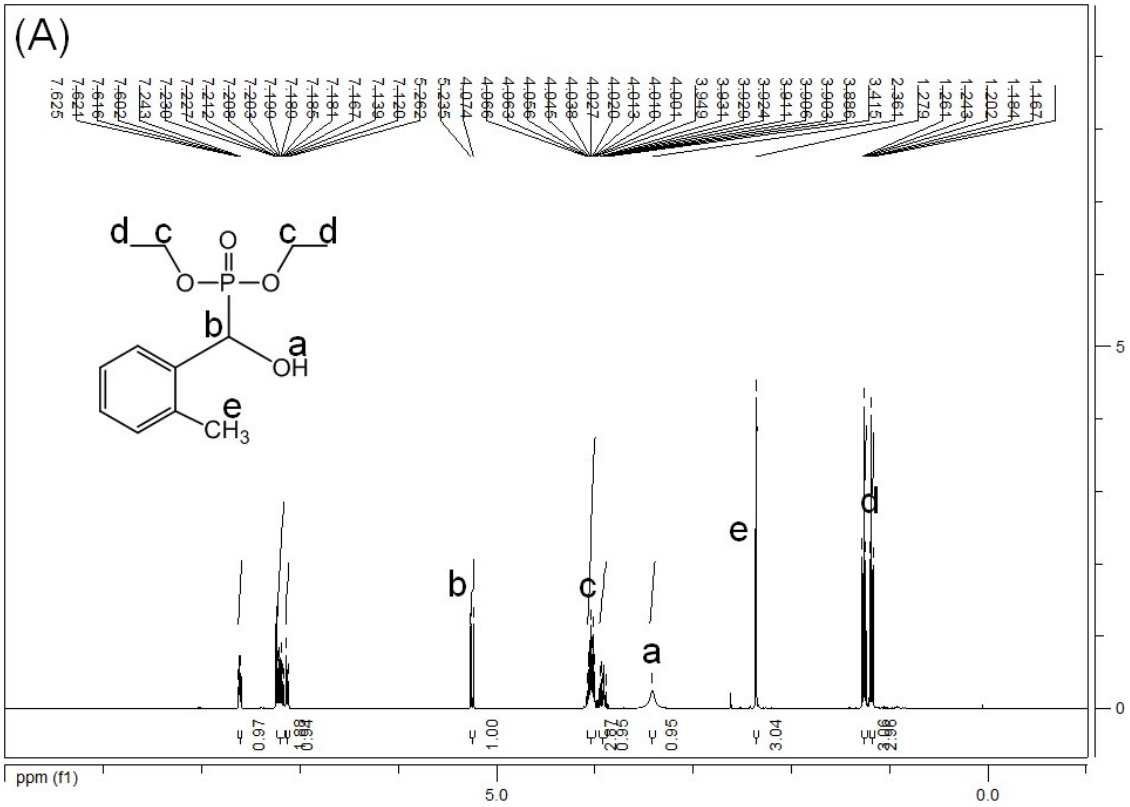


Fig. S9. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **7.**



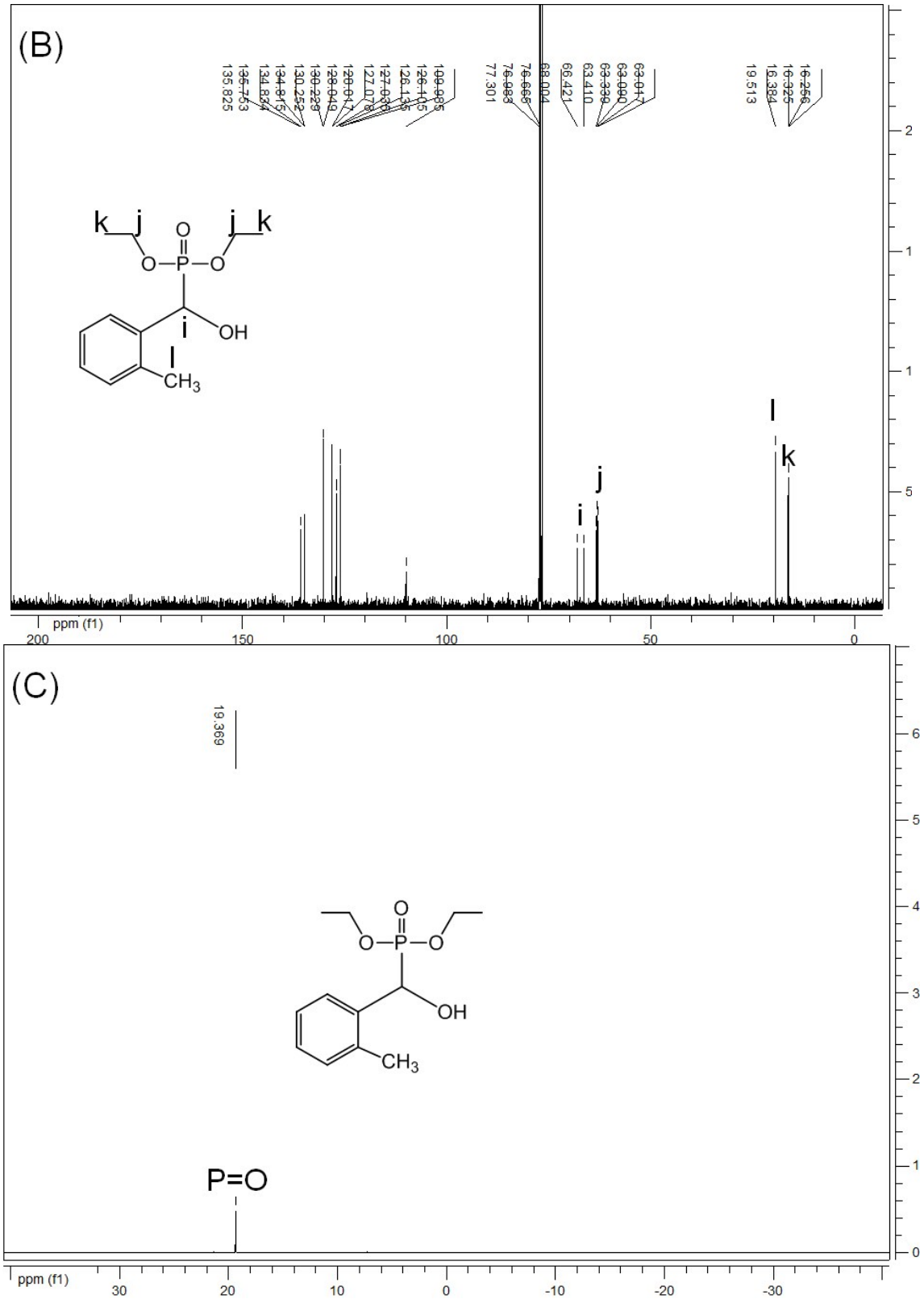
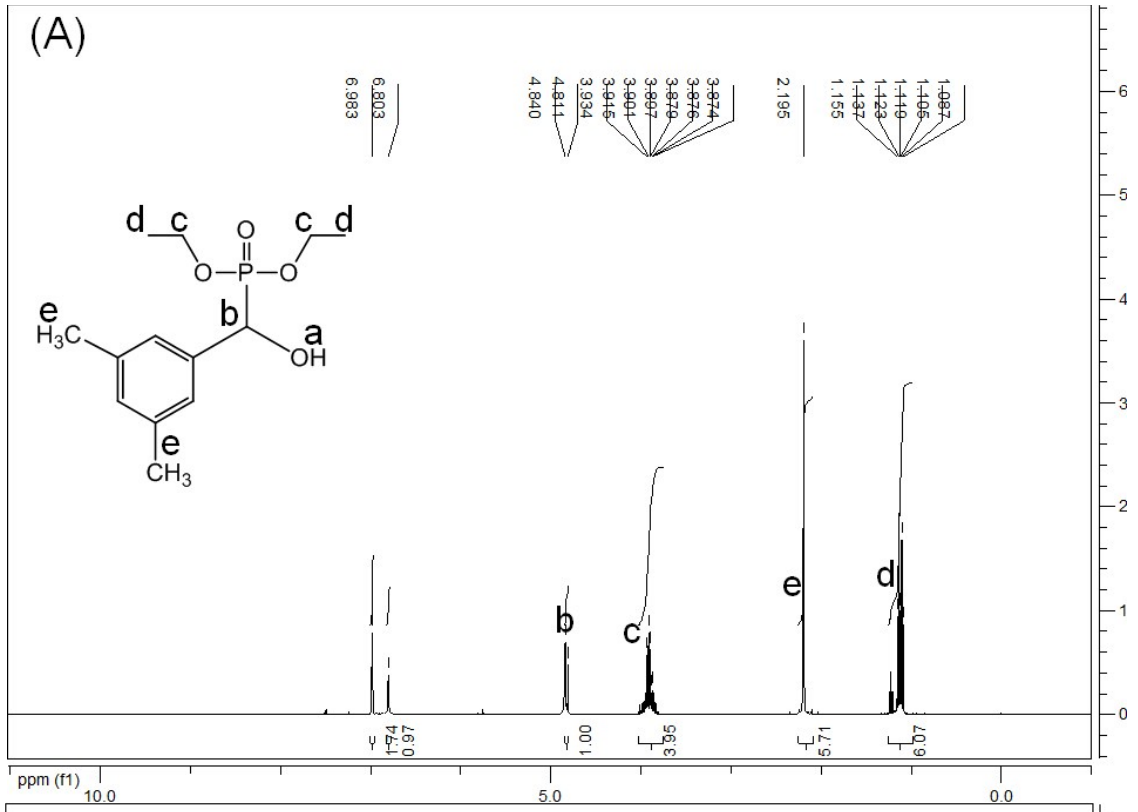
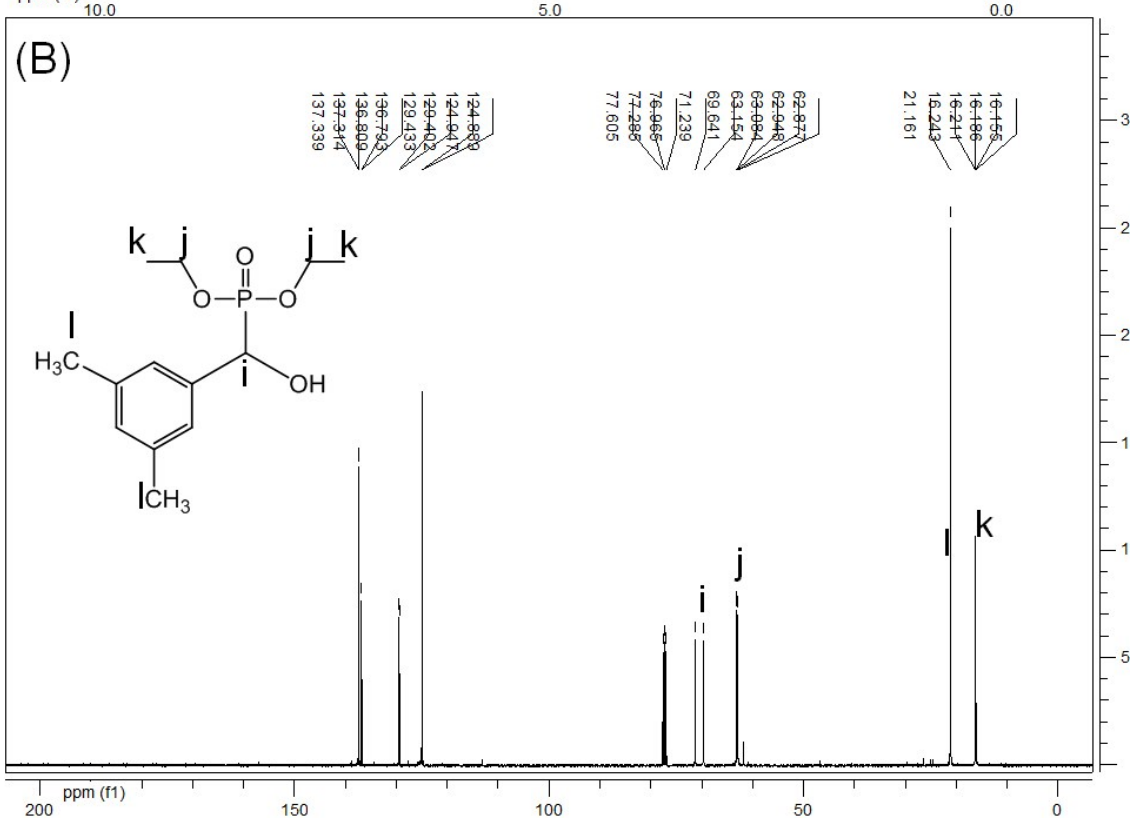


Fig. S10. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **8.**


(A)
6.983
6.803
4.840
4.811
3.934
3.915
3.901
3.887
3.879
3.876
3.874
2.195
1.155
1.137
1.123
1.119
1.105
1.087
d c
c d
O
O P O
e
H3C
b
a
OH
e
CH3
b
c
e
d
0.97
1.47
1.00
3.93
1.75
4.07
ppm (f1)
10.0
5.0
0.0


(B)
137.339
137.314
136.809
136.792
129.433
129.402
124.947
124.883
77.605
77.285
76.965
71.239
69.641
63.154
63.084
62.948
62.877
21.161
16.243
16.211
16.186
16.155
k j
j k
O
O P O
l
H3C
i
OH
l
CH3
l
k
j
i
ppm (f1)
200
150
100
50
0

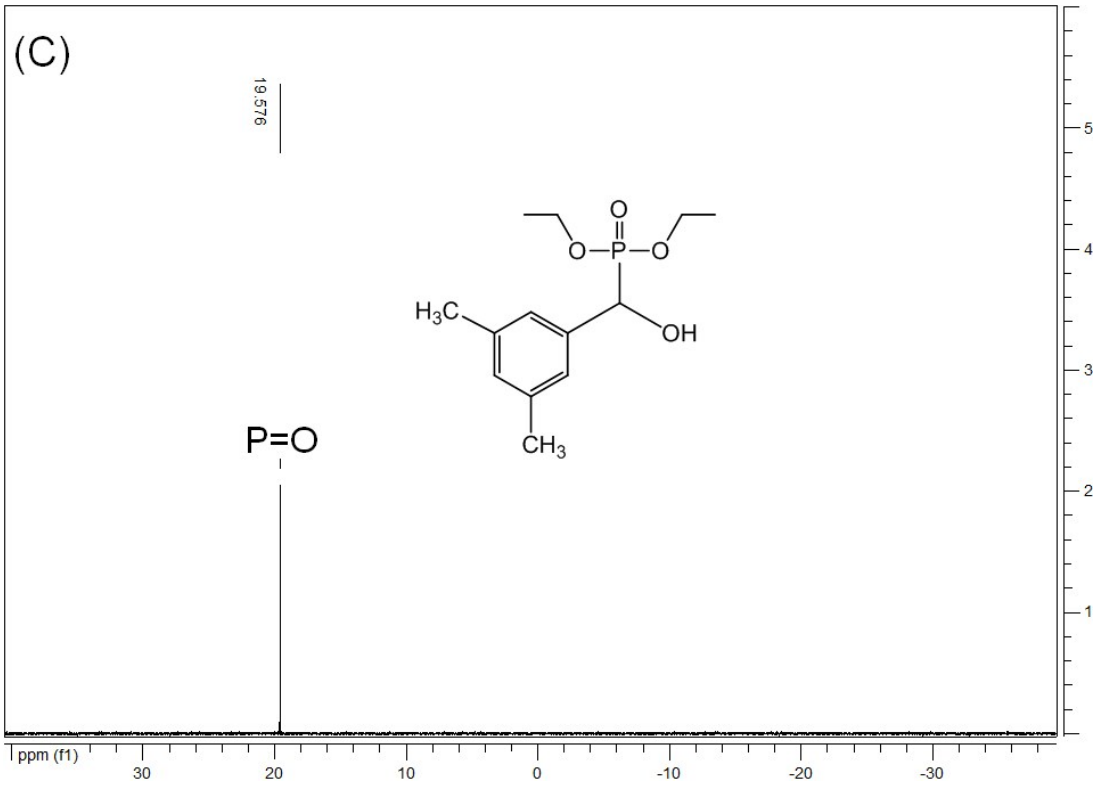
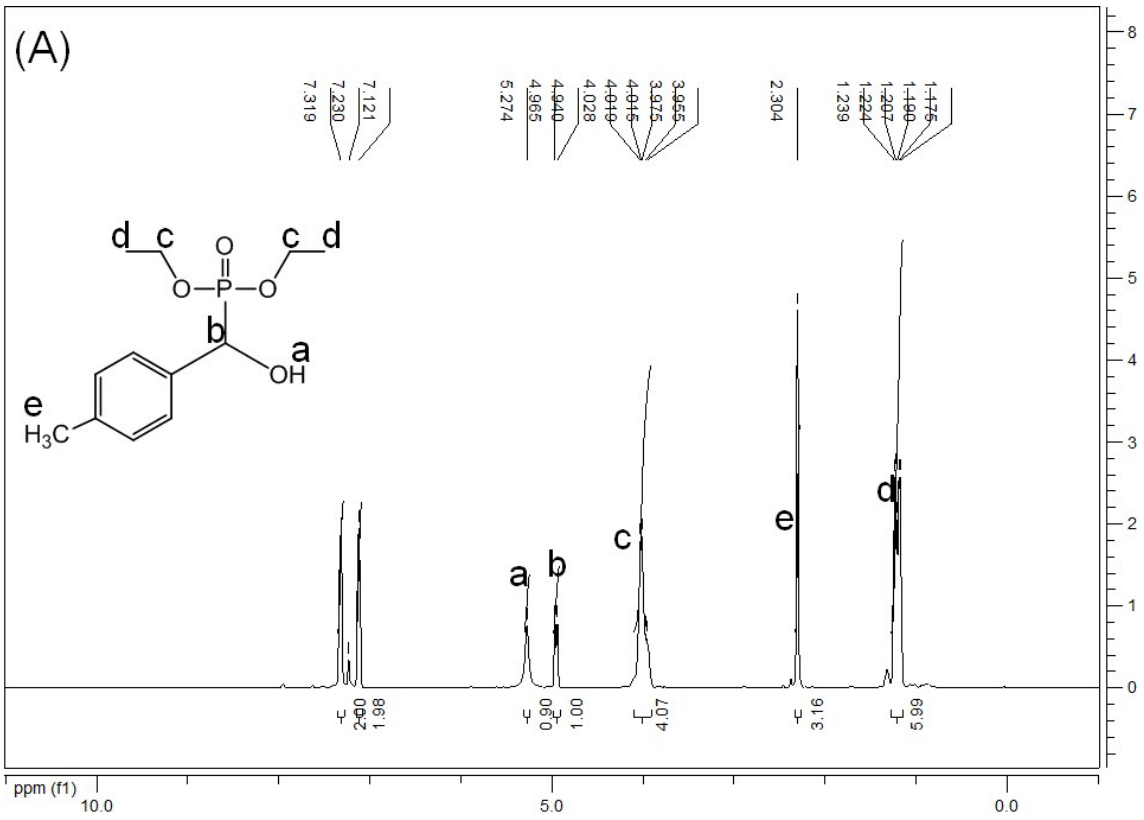


Fig. S11. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **9.**



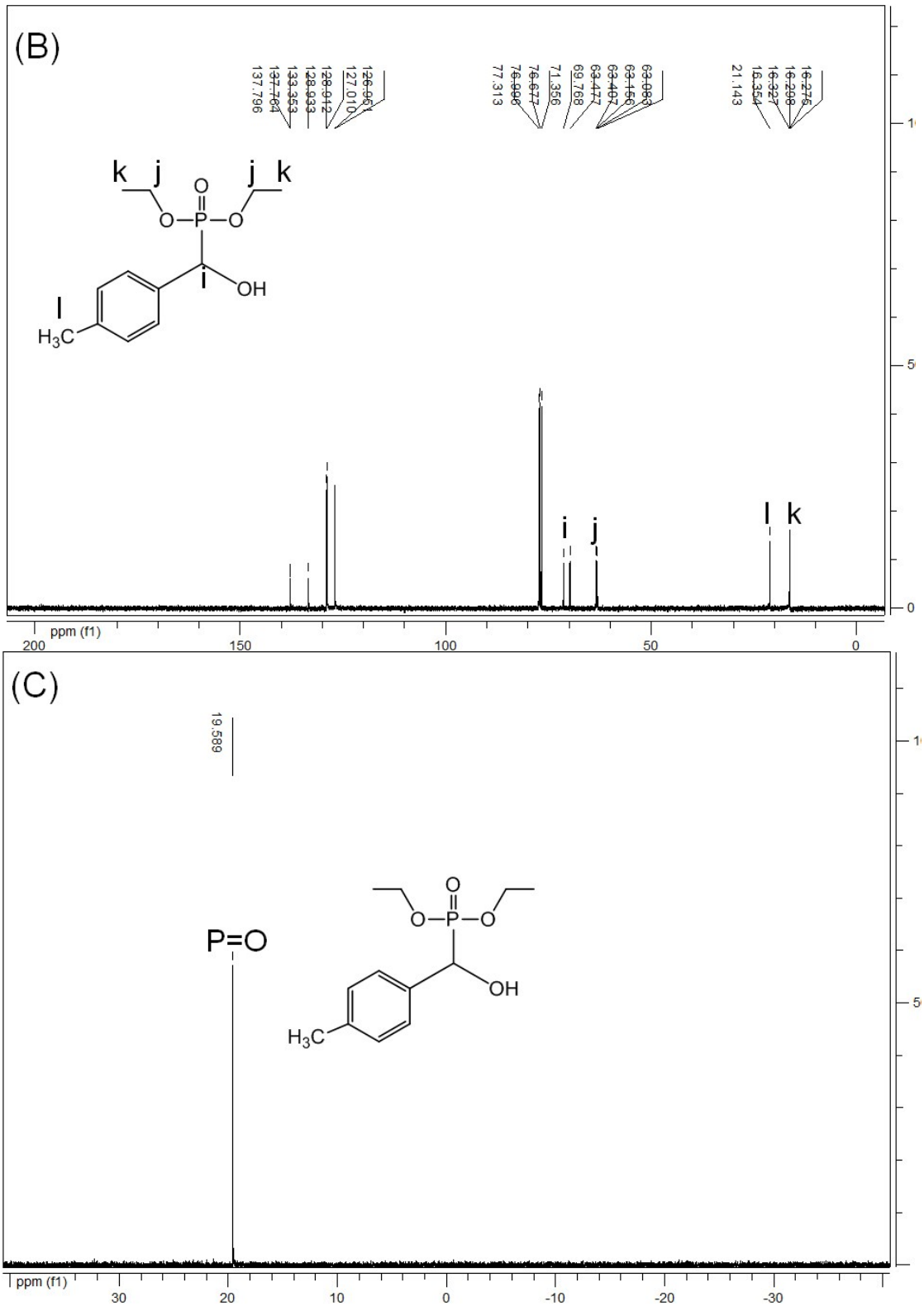
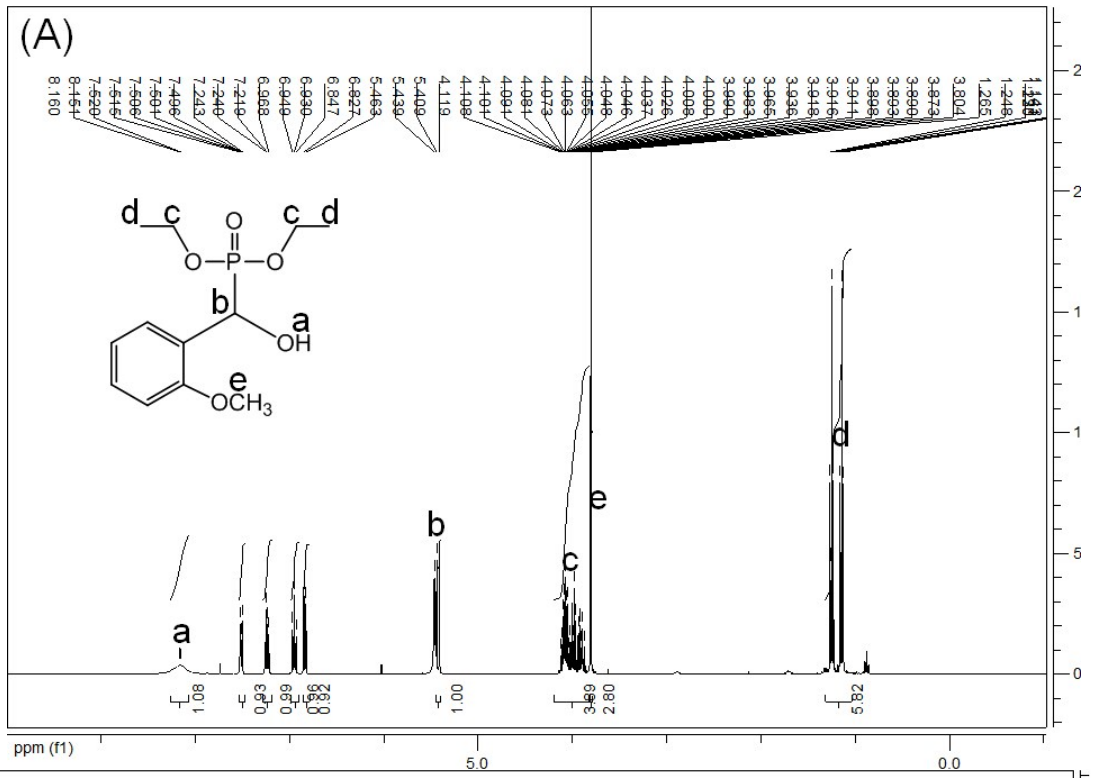
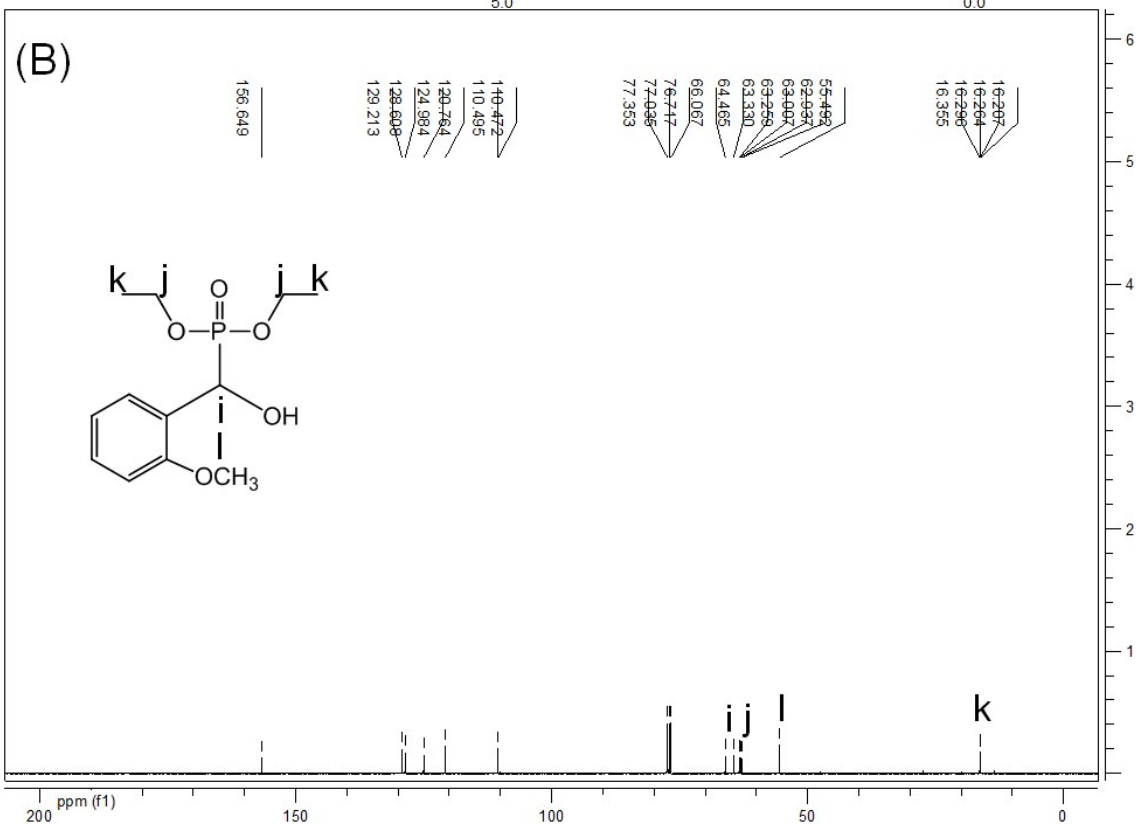


Fig. S12. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **10.**


(A)
d c O c d
O P O
b
a
OH
e
OCH3
a
b
c
e
d
ppm (f1)
5.0
0.0


(B)
156.649
129.213
128.608
124.984
120.764
110.495
110.472
77.353
77.035
76.717
66.067
64.465
63.330
63.259
63.007
62.937
55.492
16.355
16.297
16.264
16.230
k j O j k
O P O
i
OH
l
OCH3
i j l k
200
ppm (f1)
150
100
50
0

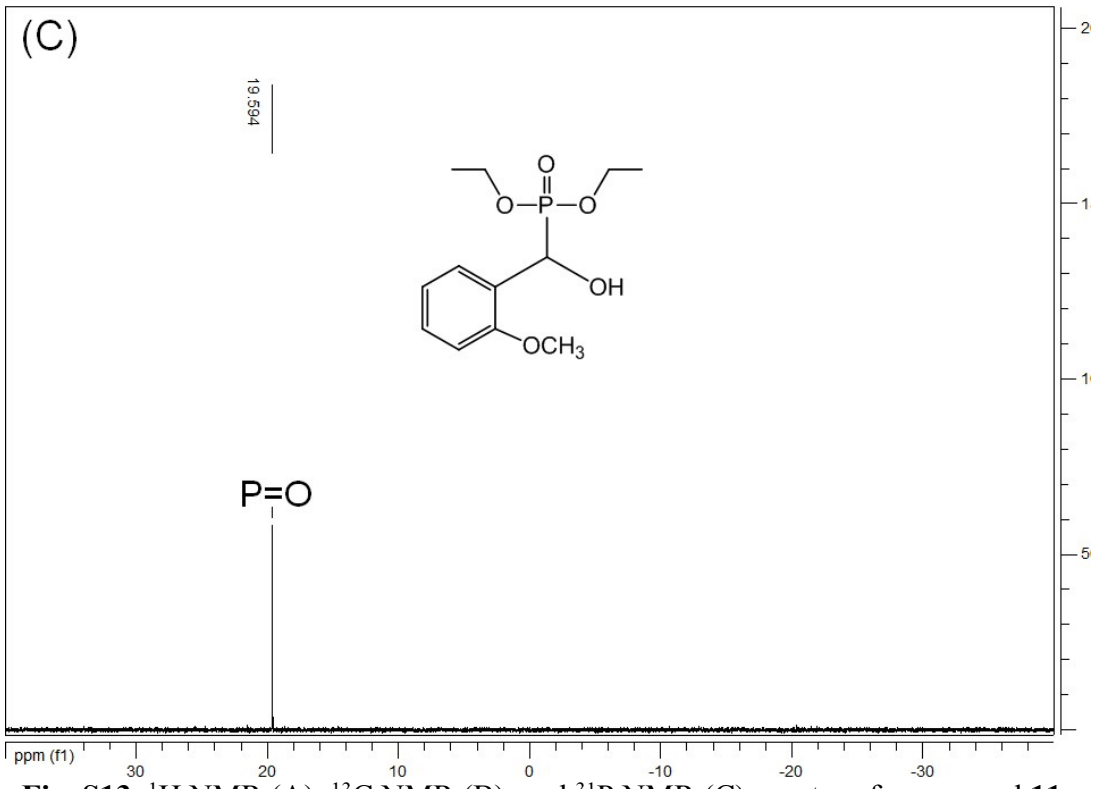
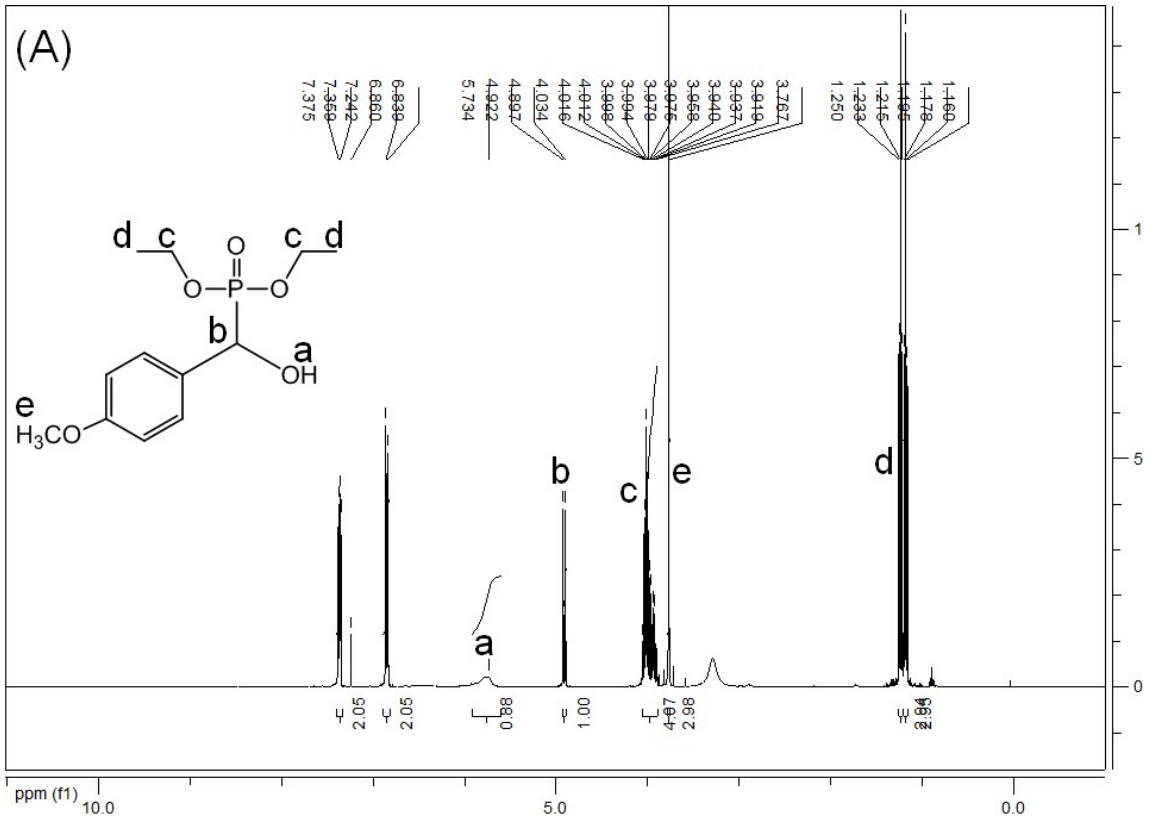


Fig. S13. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **11.**



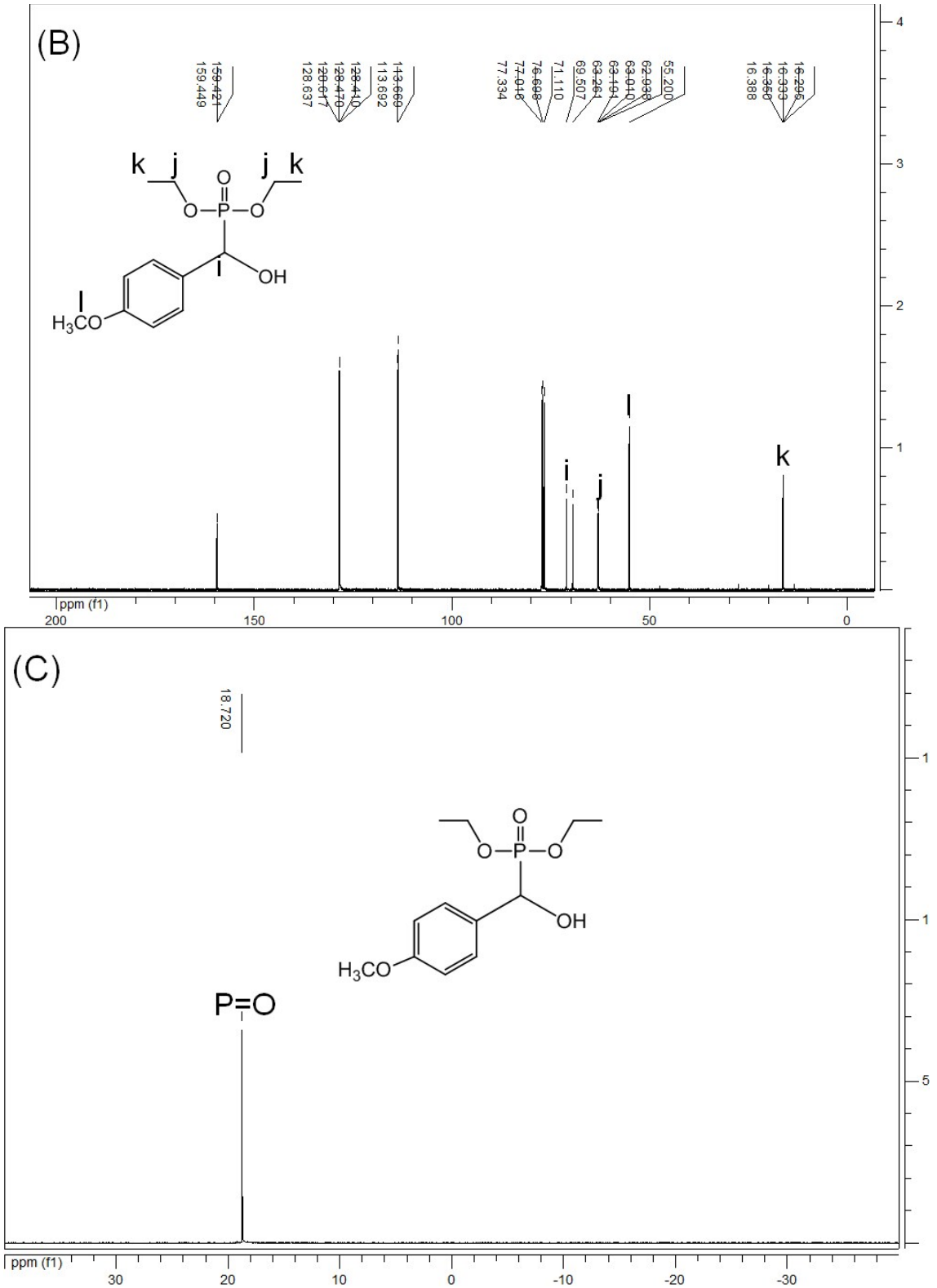
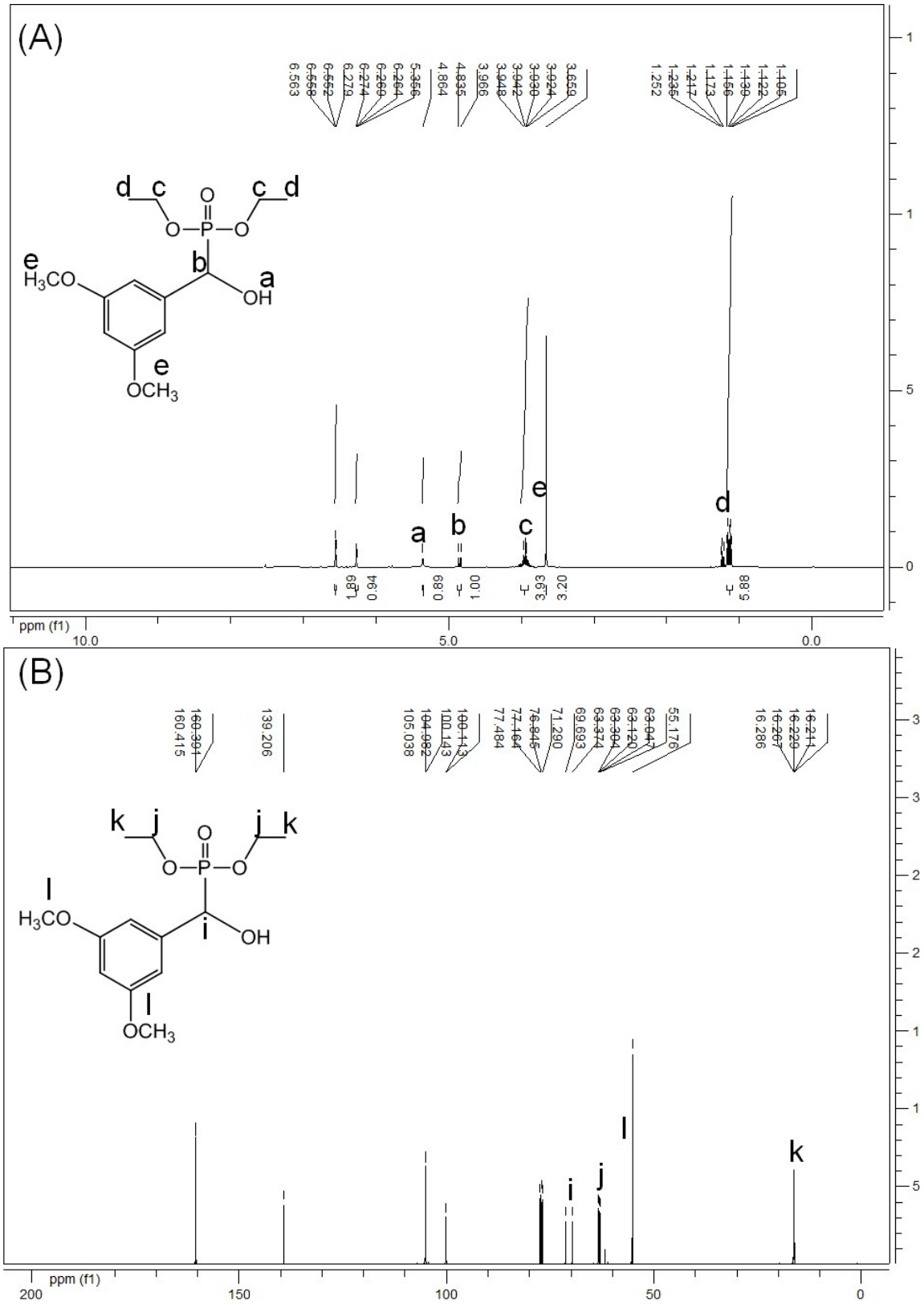


Fig. S14. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **12.**


(A)
6.563
6.558
6.552
6.279
6.274
6.269
6.264
5.366
4.864
4.835
3.966
3.948
3.942
3.930
3.924
3.659
1.252
1.235
1.217
1.173
1.156
1.139
1.122
1.105
d c
c d
e
H3CO
b
a
OH
e
OCH3
a
b
c
e
d
ppm (f1)
10.0
5.0
0.0
(B)
160.391
160.415
139.206
105.038
77.484
71.290
69.693
63.374
55.176
16.286
k j
j k
l
H3CO
i
OH
l
OCH3
i
j
l
k
ppm (f1)
200
150
100
50
0

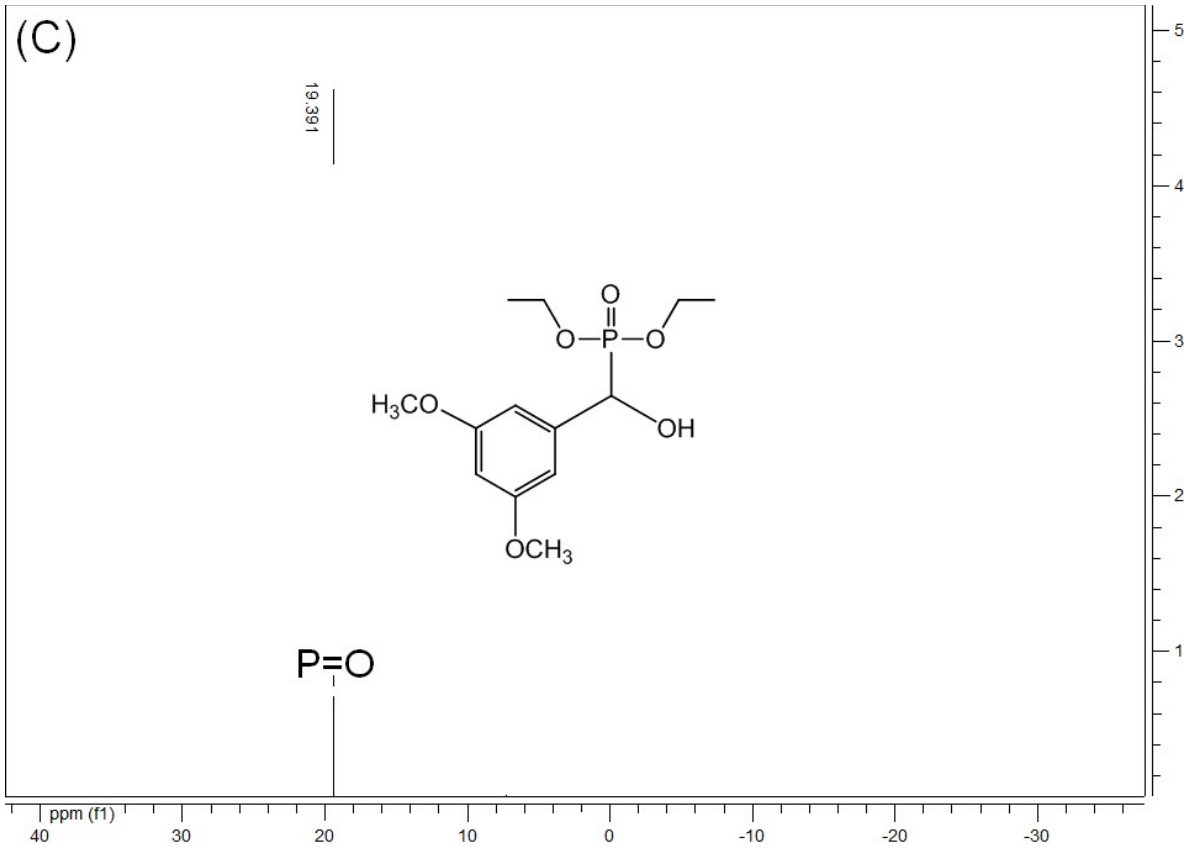
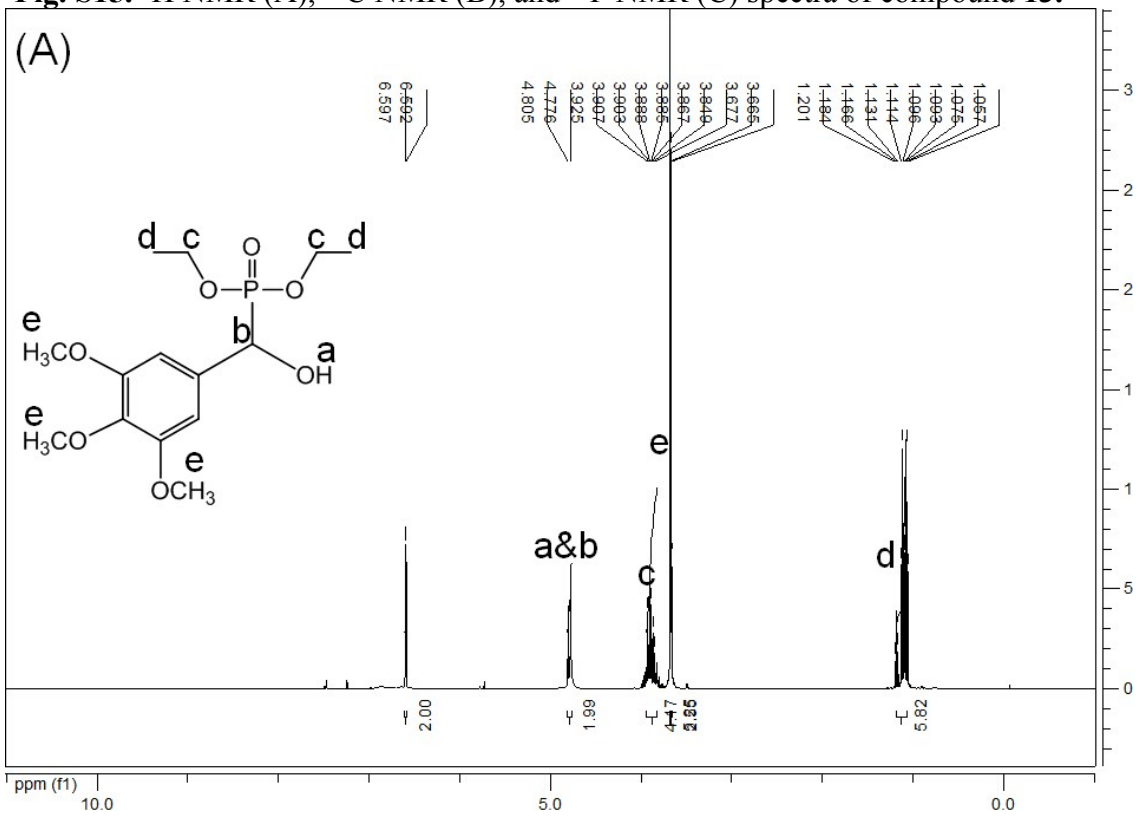


Fig. S15. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **13.**



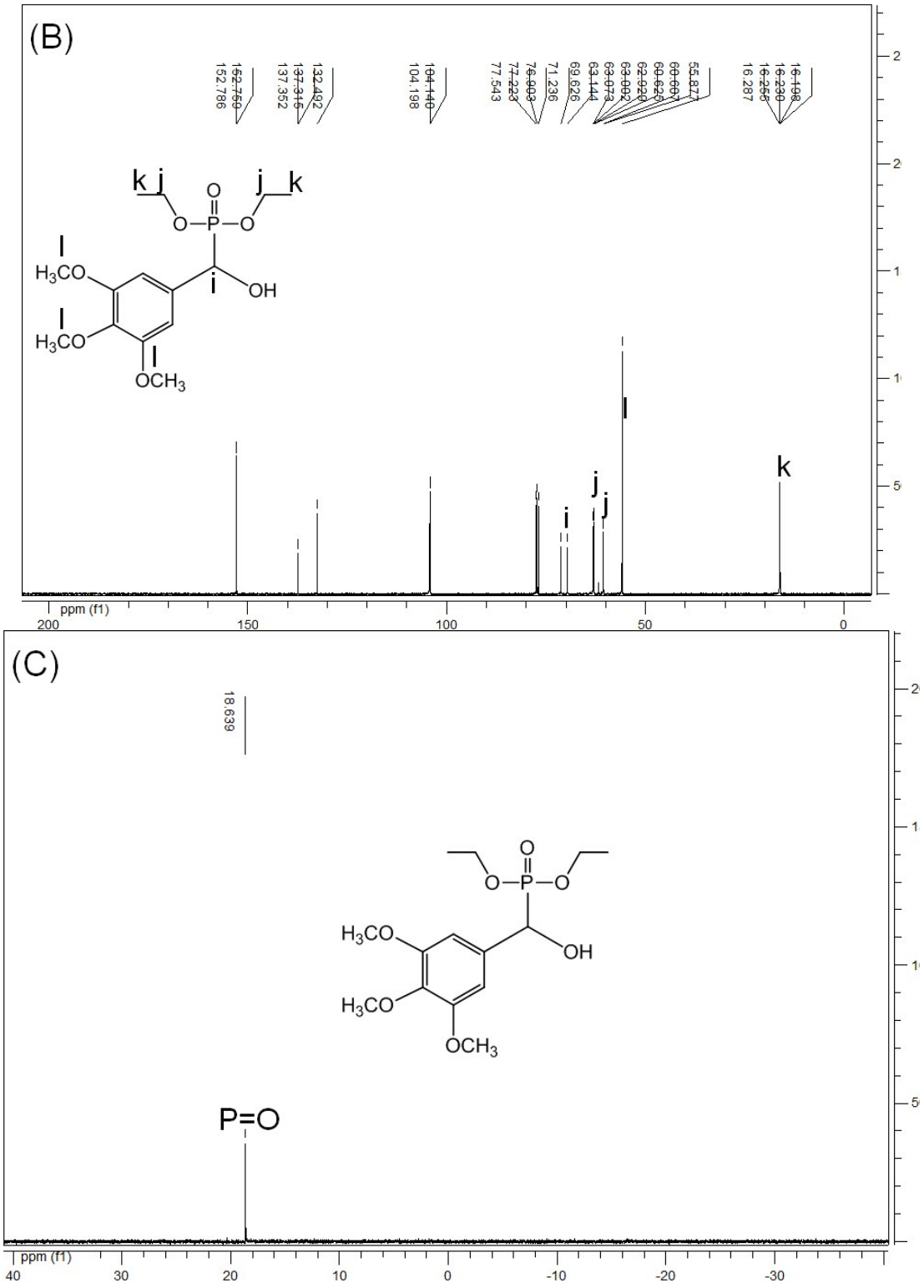
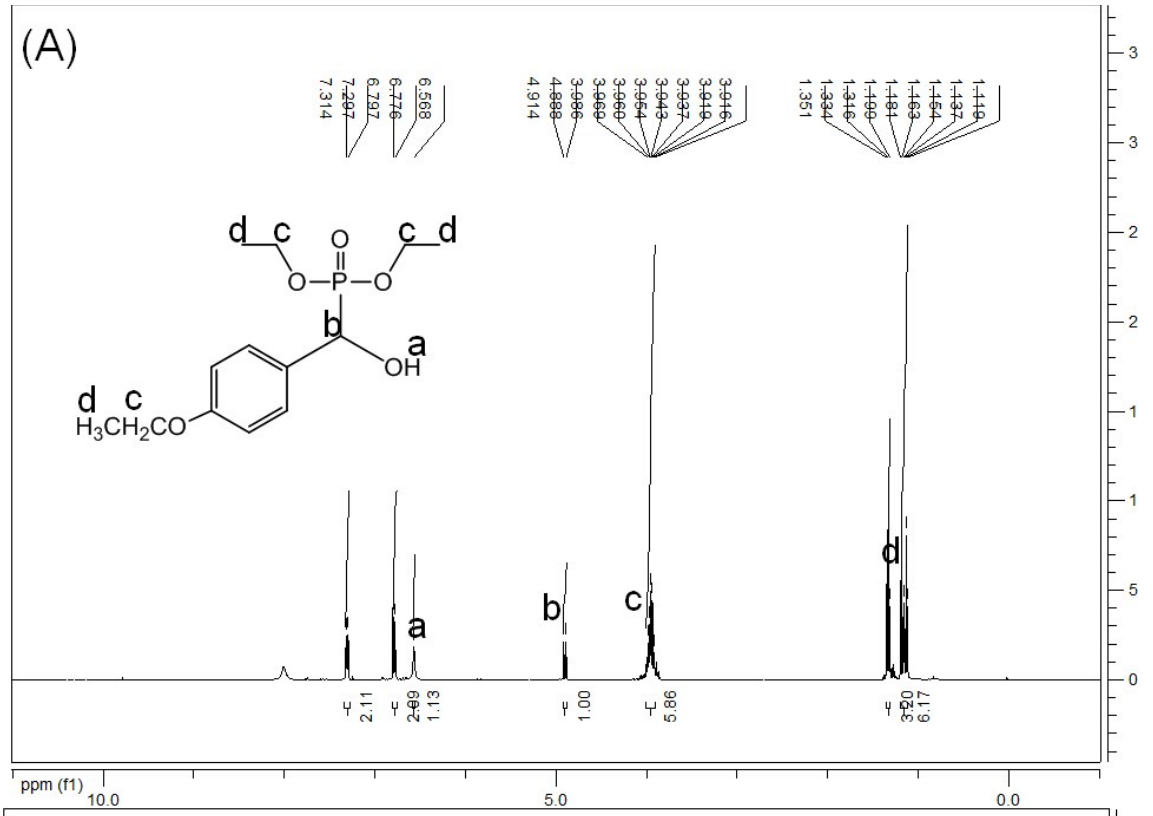
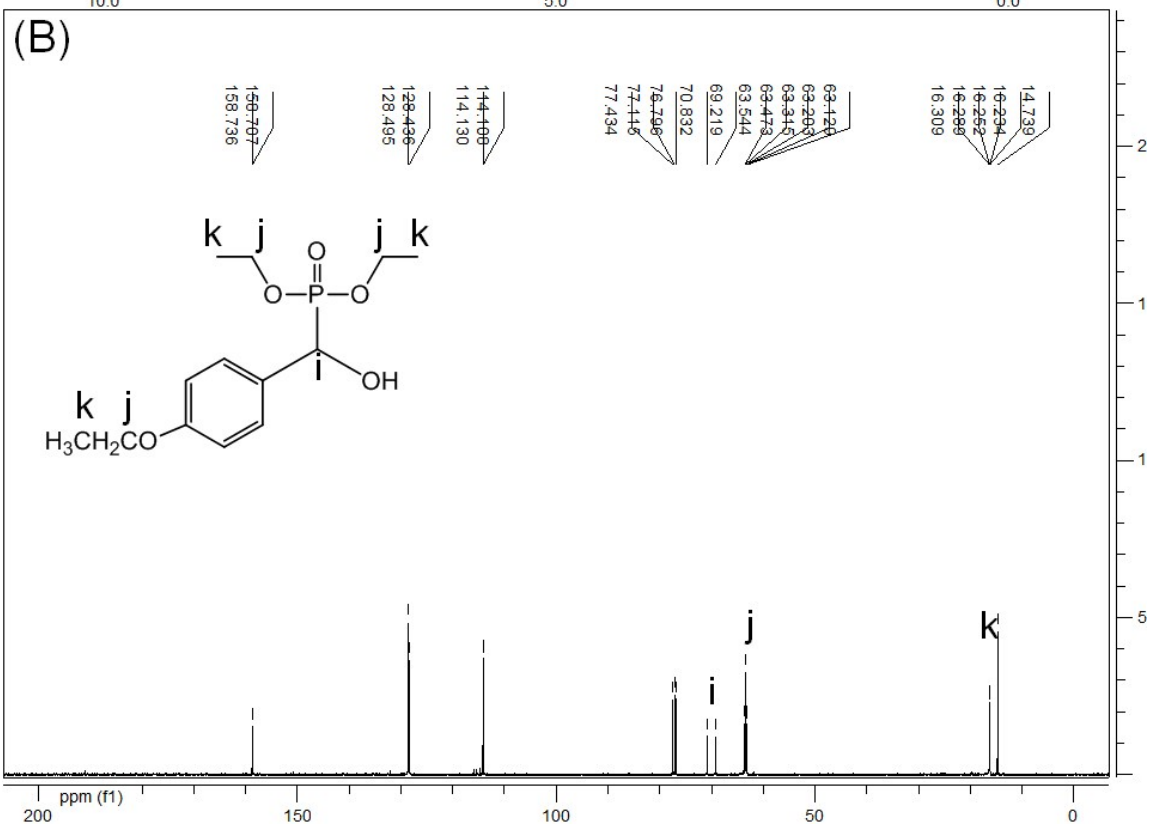


Fig. S16. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **14.**


(A)
7.314
7.297
6.797
6.776
6.568
4.914
4.888
3.986
3.969
3.960
3.954
3.943
3.937
3.919
3.916
1.351
1.334
1.316
1.299
1.181
1.163
1.154
1.137
1.119
d c
c d
b
a
OH
d c
H3CH2CO
a
b
c
d
2.11
2.00
1.13
1.00
9.85
3.20
6.17
ppm (f1)
10.0
5.0
0.0


(B)
158.736
150.707
128.436
128.495
114.130
114.100
77.434
77.116
76.796
70.832
69.219
63.544
63.473
63.315
63.203
63.120
16.309
16.286
16.252
16.234
14.739
k j
j k
O
O P O
i
OH
k j
H3CH2CO
j
i
k
ppm (f1)
200
150
100
50
0

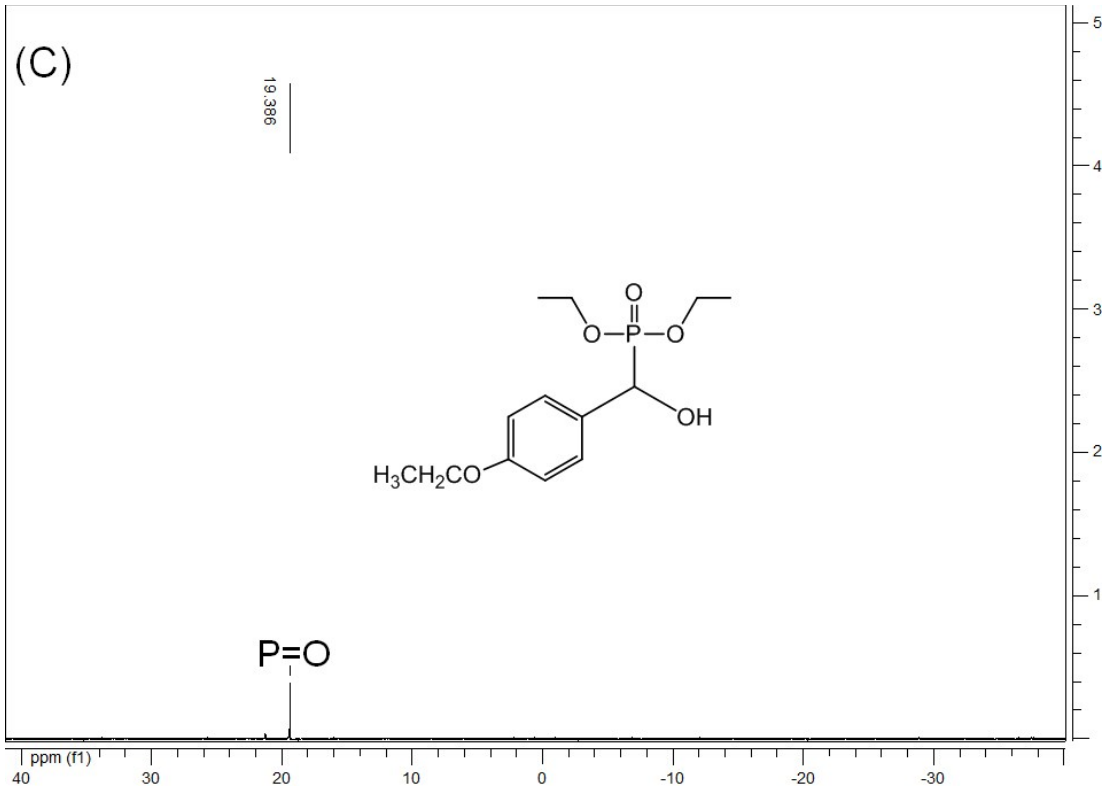
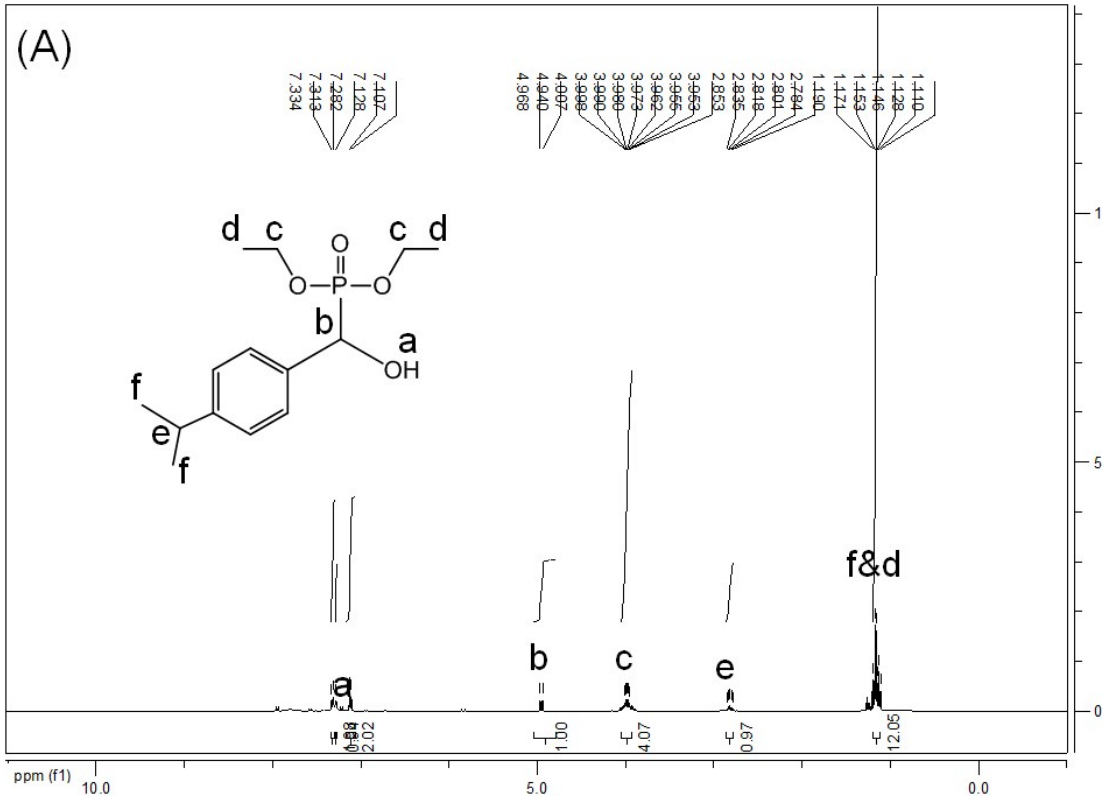


Fig. S17. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **15.**



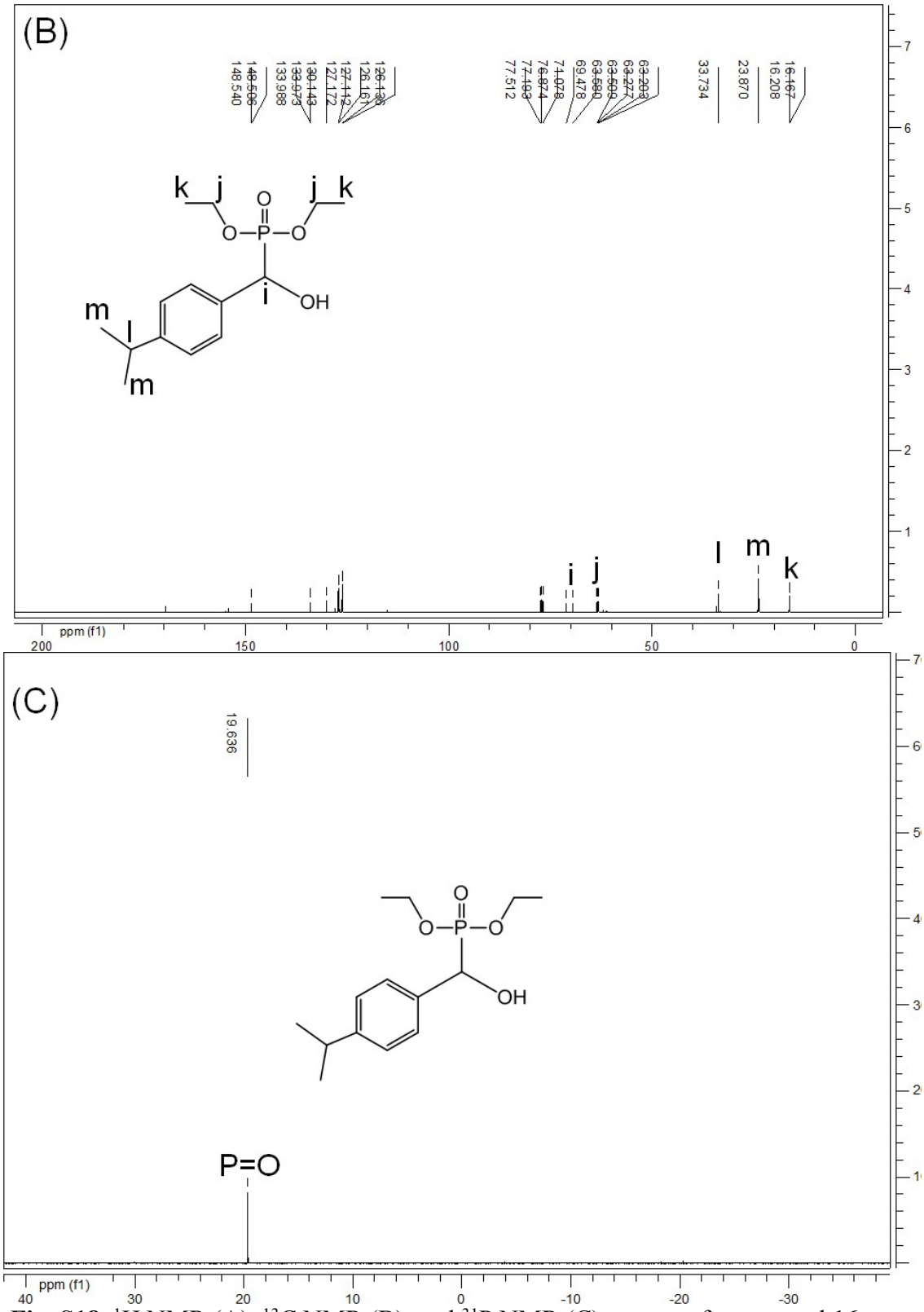
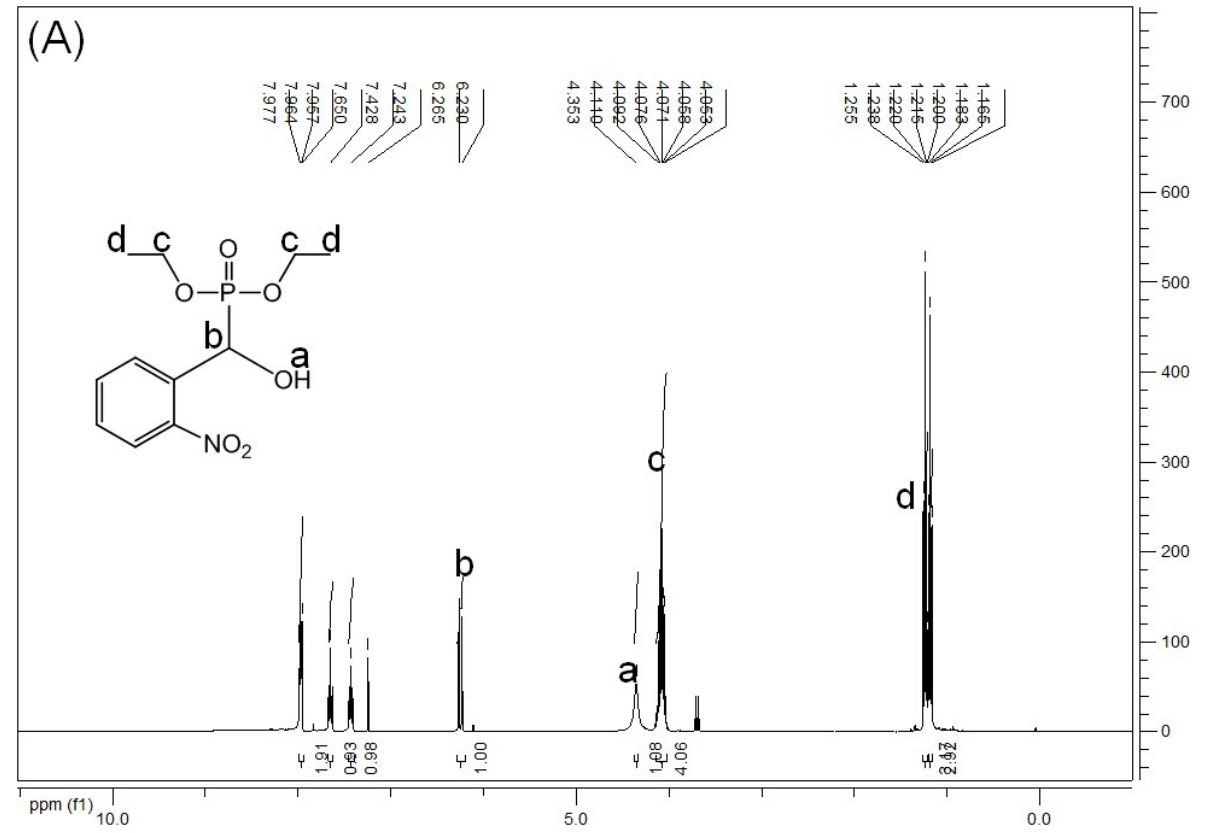
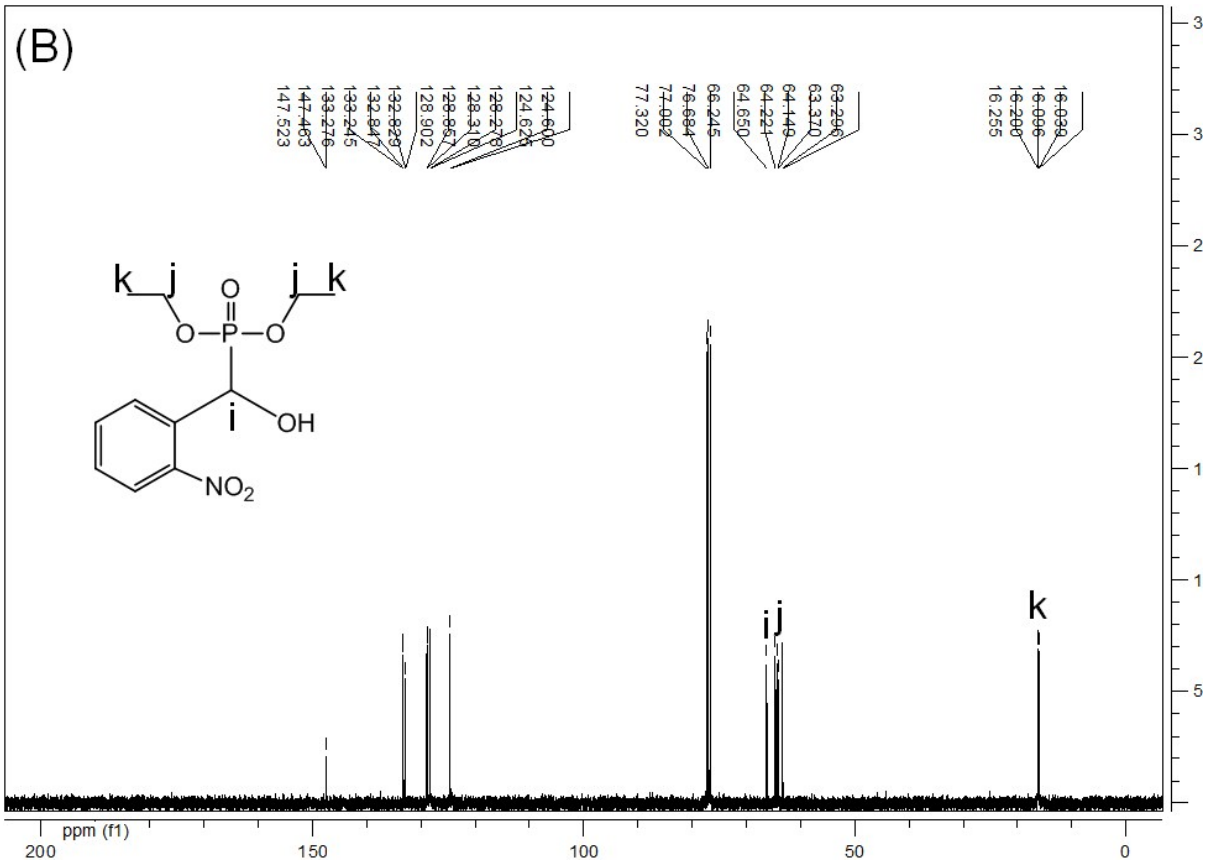


Fig. S18. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **16.**


(A)
7.977
7.964
7.957
7.650
7.428
7.243
6.265
6.230
4.353
4.110
4.092
4.076
4.071
4.058
4.053
1.255
1.238
1.220
1.215
1.200
1.183
1.165
d c
O
c d
O P O
b
a
OH
NO2
a
b
c
d
1.71
0.63
0.60
0.98
1.00
1.08
1.00
4.06
3.00
2.47
2.78
ppm (f1)
10.0
5.0
0.0
700
600
500
400
300
200
100
0


(B)
147.523
147.463
133.276
133.245
132.847
132.829
128.902
128.857
128.310
128.278
124.626
124.600
77.320
77.002
76.684
66.245
64.650
64.221
64.149
63.370
63.296
16.255
16.200
16.096
16.039
k j
O
j k
O P O
i
OH
NO2
i
j
k
ppm (f1)
200
150
100
50
0
3
3
2
2
1
1
5

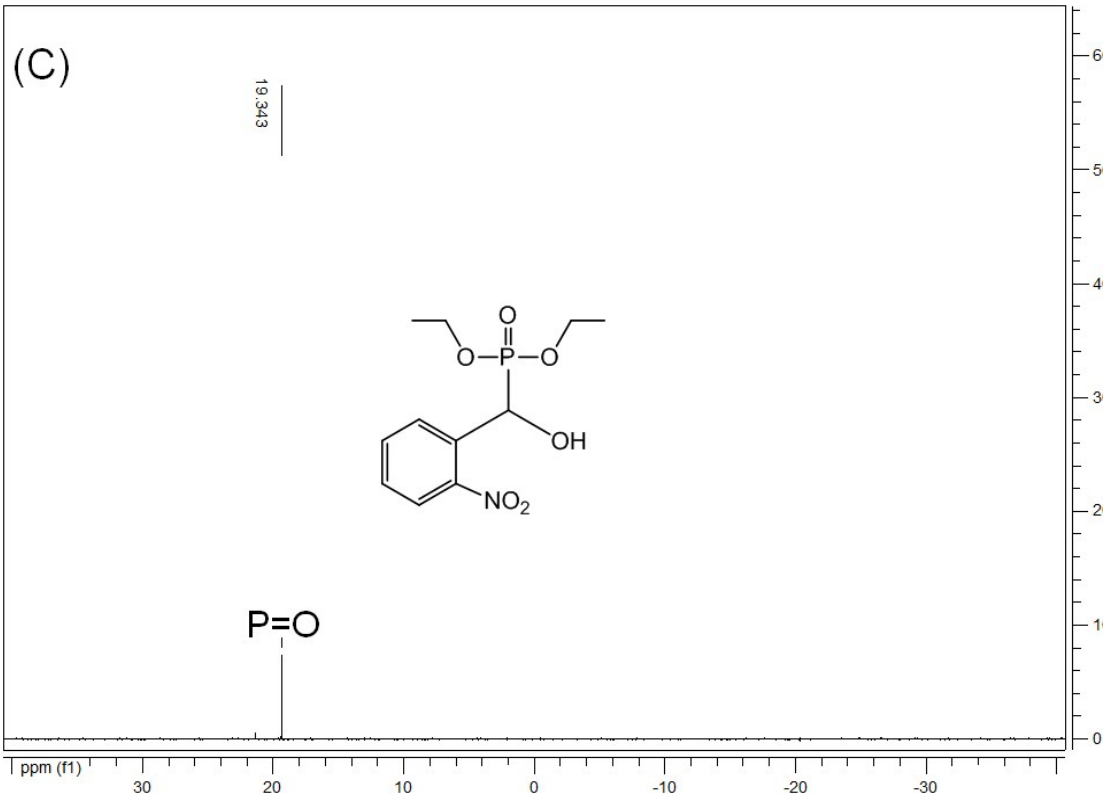


Fig. S19. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **17.**

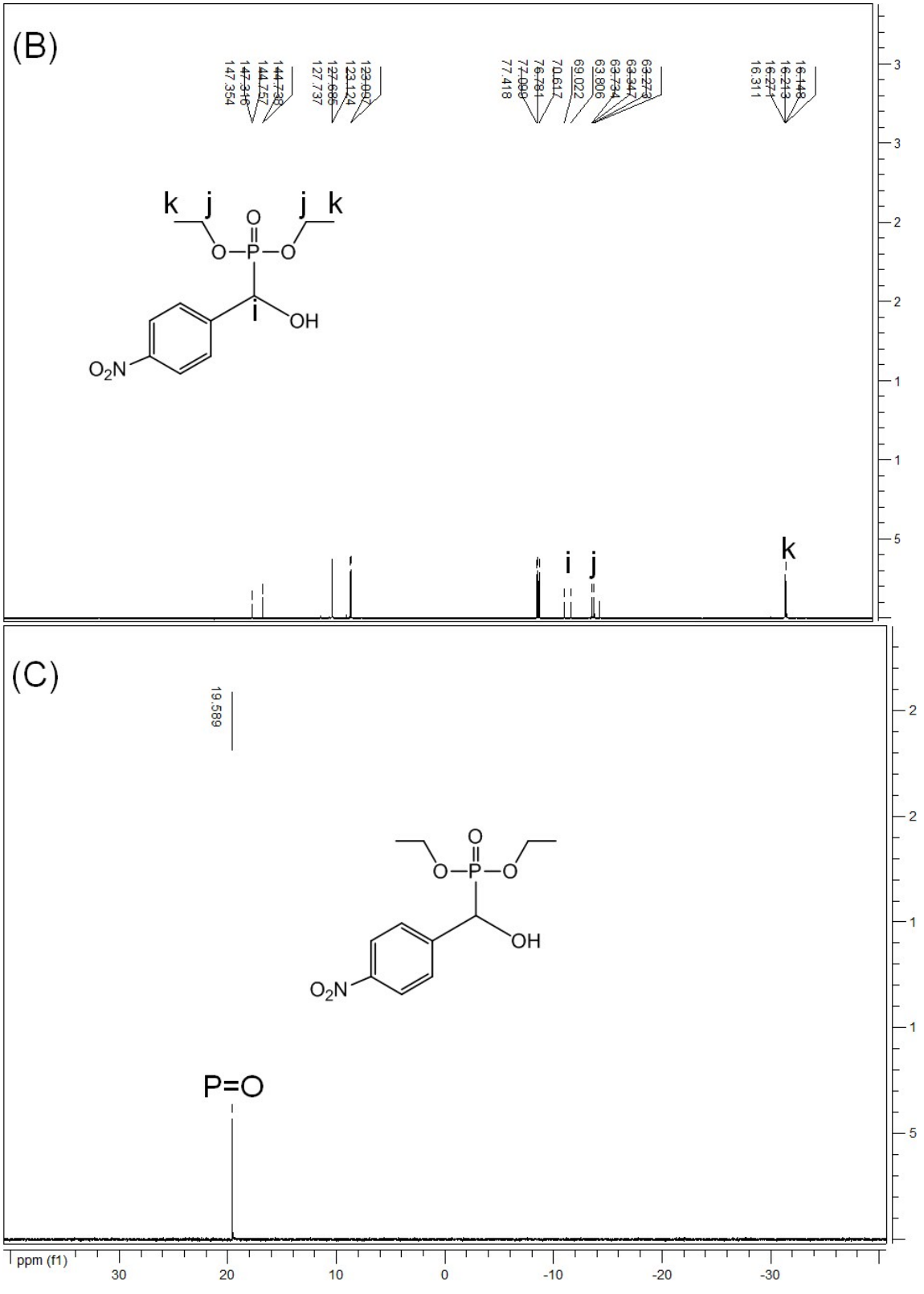
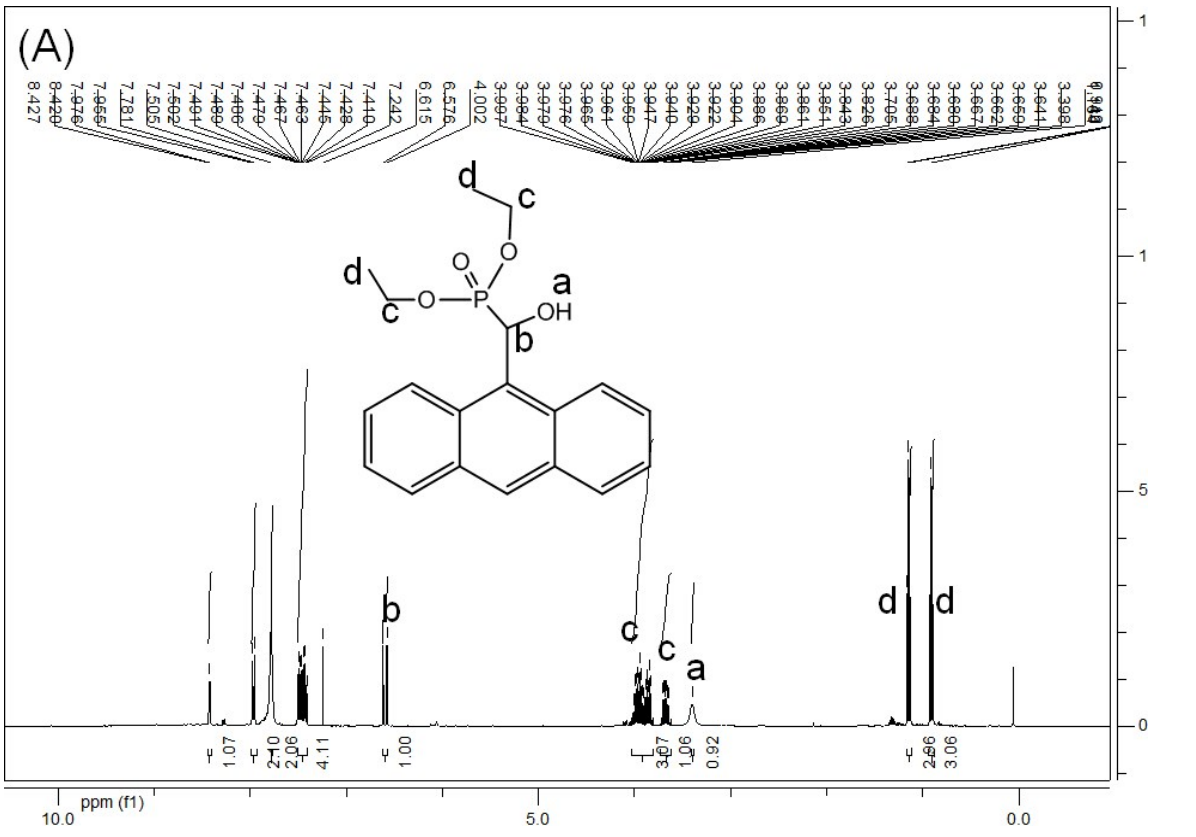
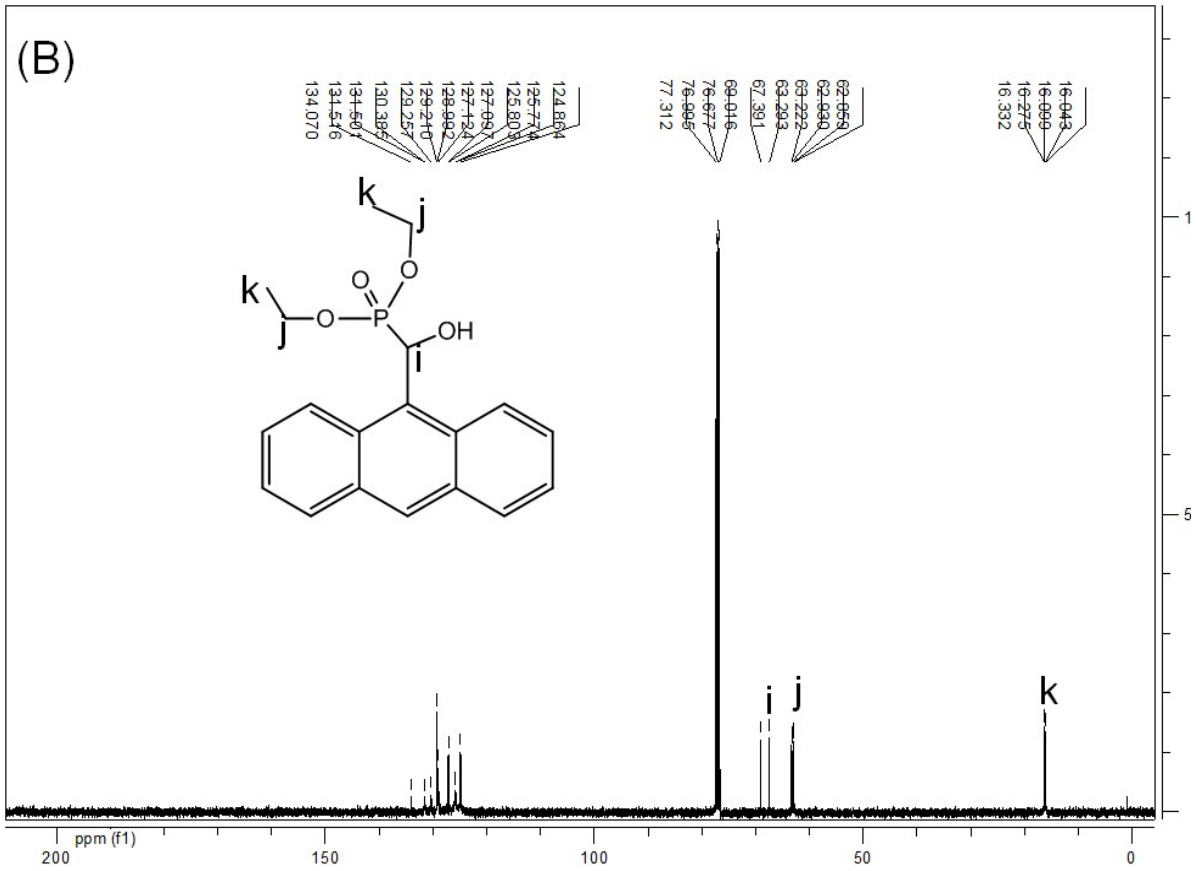


Fig. S20. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **18.**


(A)
d
c
O
O
P
a
OH
b
d
c
b
c
c
a
d
d
ppm (f1)
10.0
5.0
0.0


(B)
k
j
O
O
P
k
j
OH
i
i
j
k
ppm (f1)
200
150
100
50
0

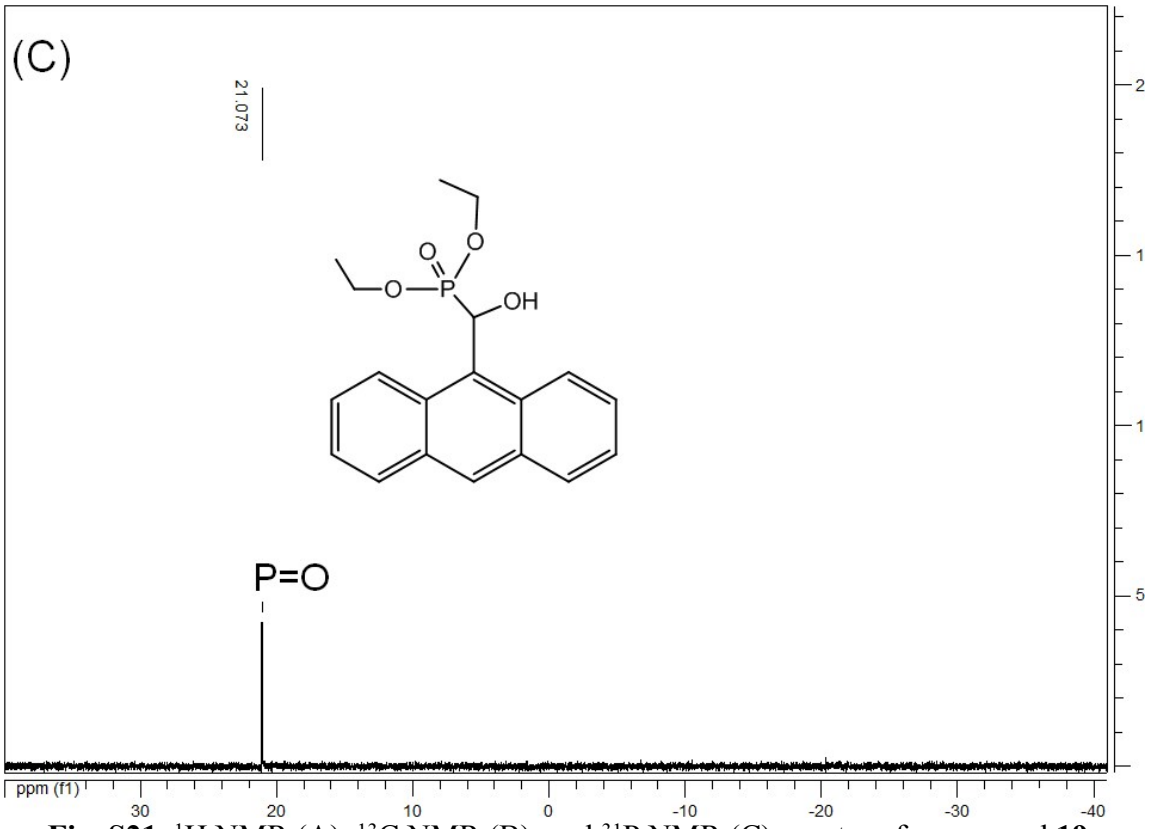
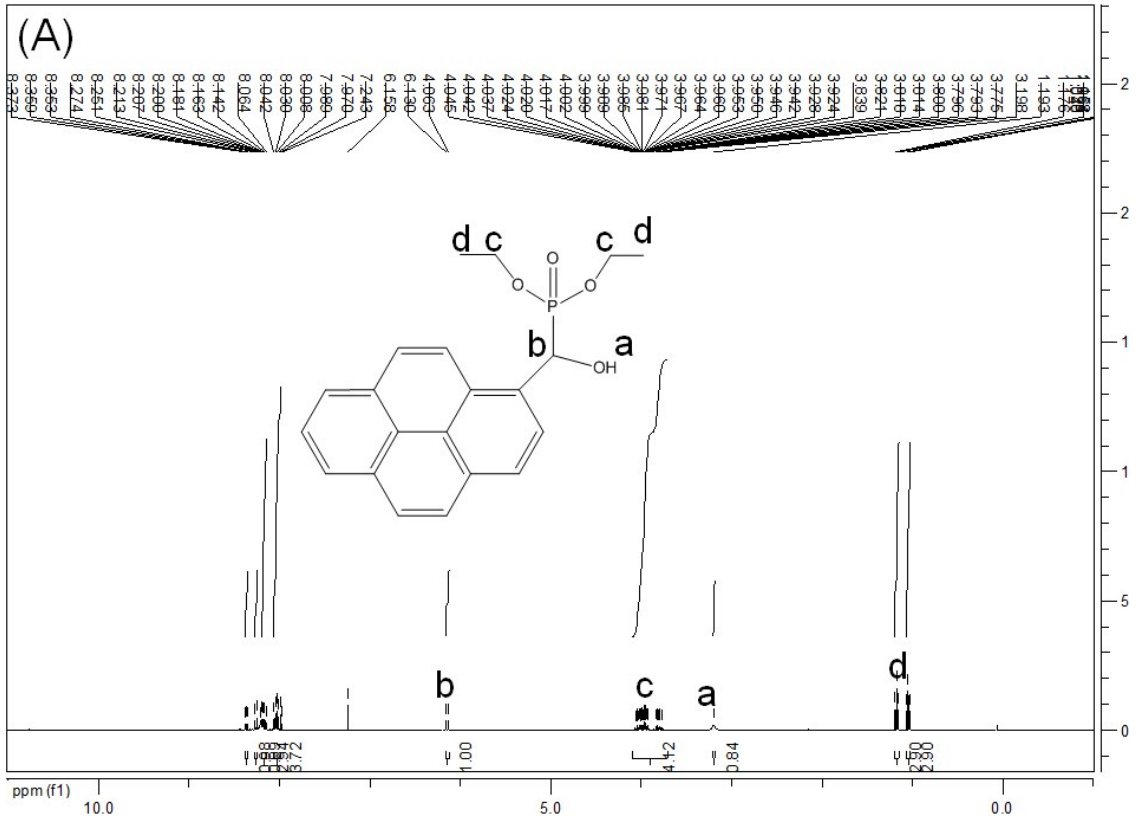


Fig. S21. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **19.**



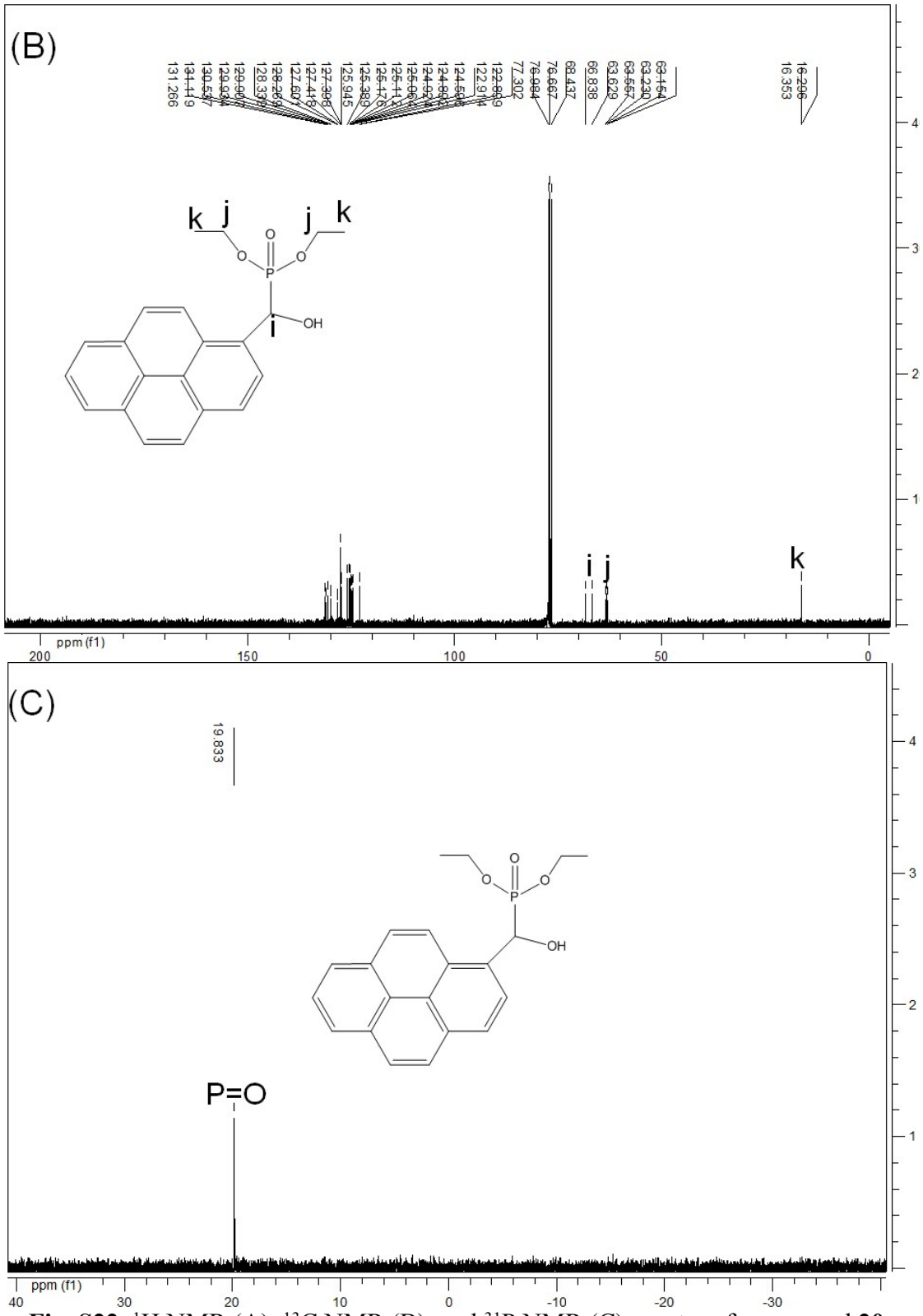
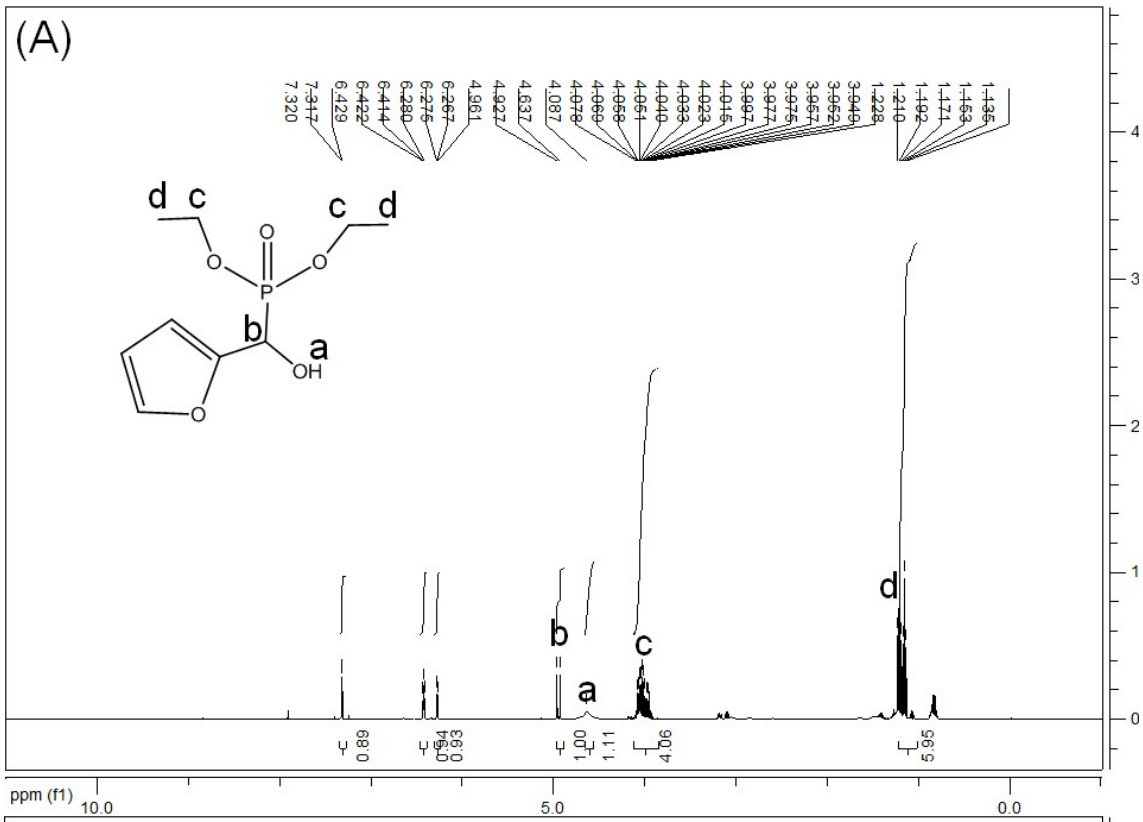
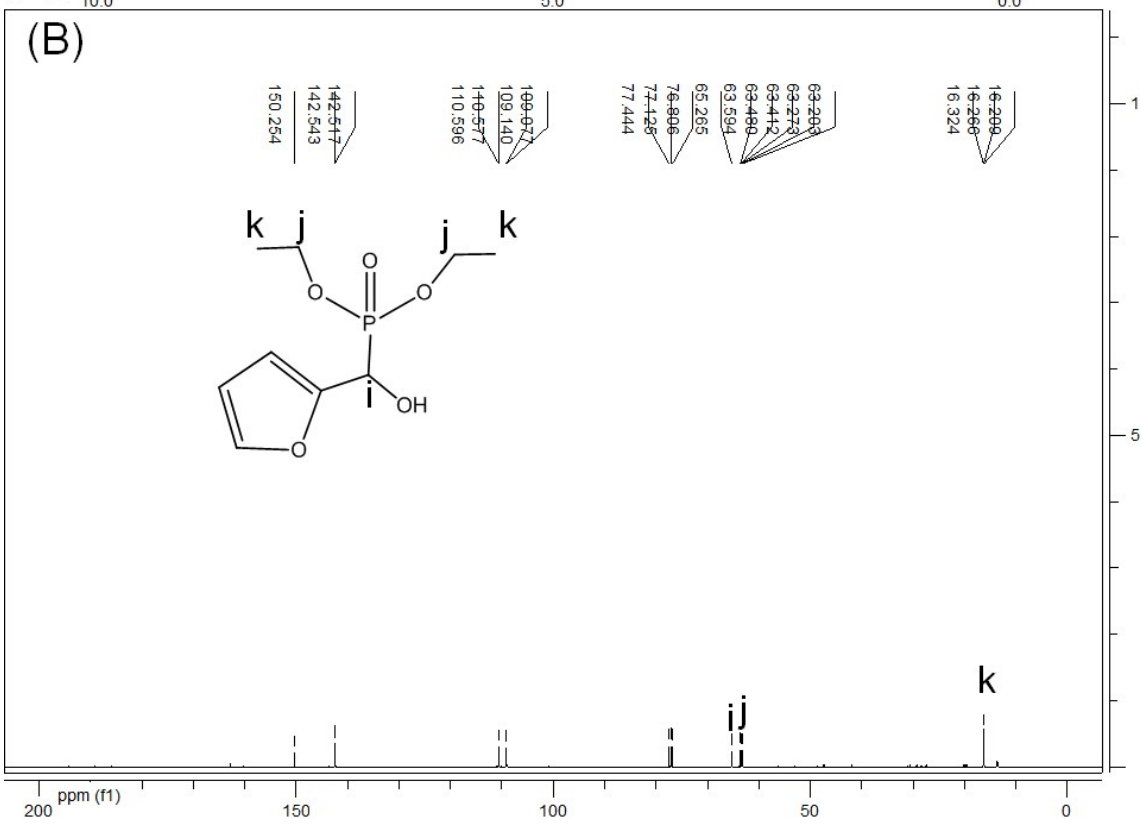


Fig. S22. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **20.**


(A)
d c
c d
O
O
O
P
b
a
OH
O
7.320
7.317
6.429
6.422
6.414
6.280
6.275
6.267
4.961
4.927
4.637
4.087
4.078
4.069
4.058
4.051
4.040
4.033
4.023
4.016
3.997
3.977
3.975
3.957
3.952
3.940
1.228
1.210
1.192
1.171
1.153
1.135
b
a
c
d
0.89
0.94
0.93
1.00
1.11
4.06
5.96
ppm (f1)
10.0
5.0
0.0


(B)
150.254
142.517
142.543
110.596
110.577
109.140
109.077
77.444
77.125
76.806
65.265
63.594
63.480
63.412
63.273
63.203
16.324
16.266
16.209
k j
j k
O
O
O
P
i
OH
O
k
i j
ppm (f1)
200
150
100
50
0

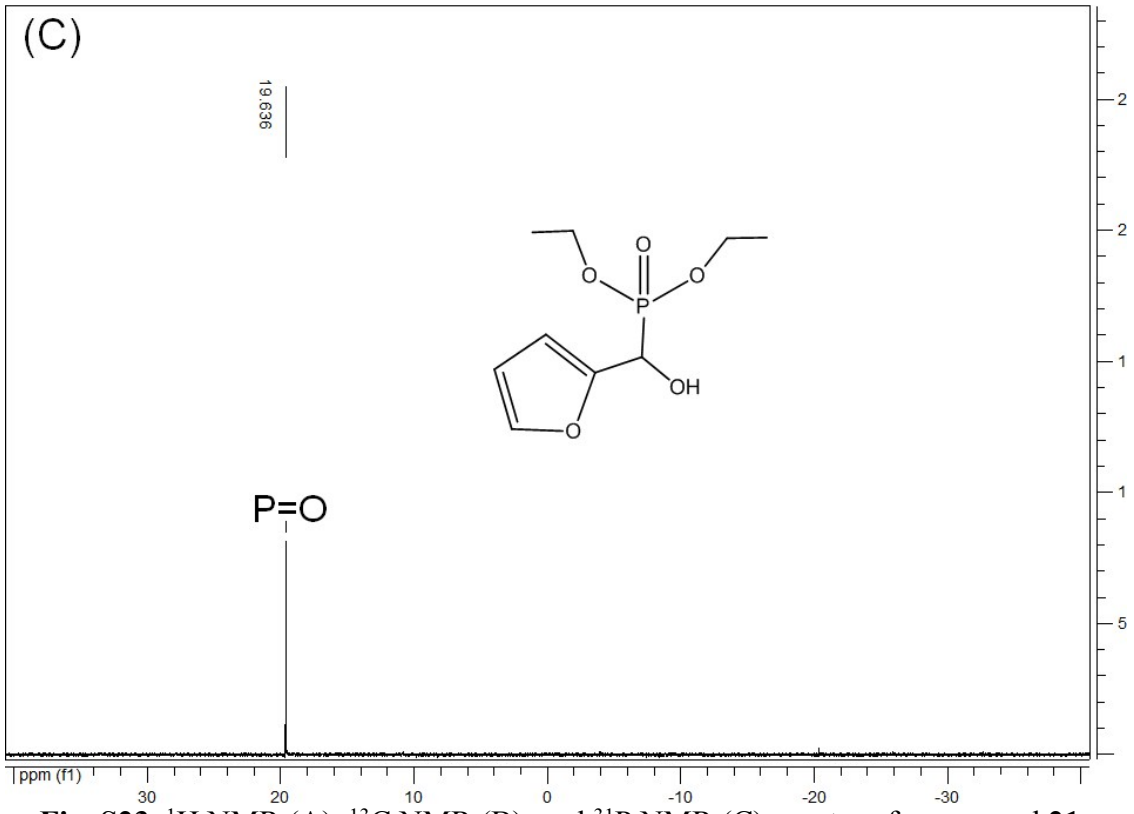
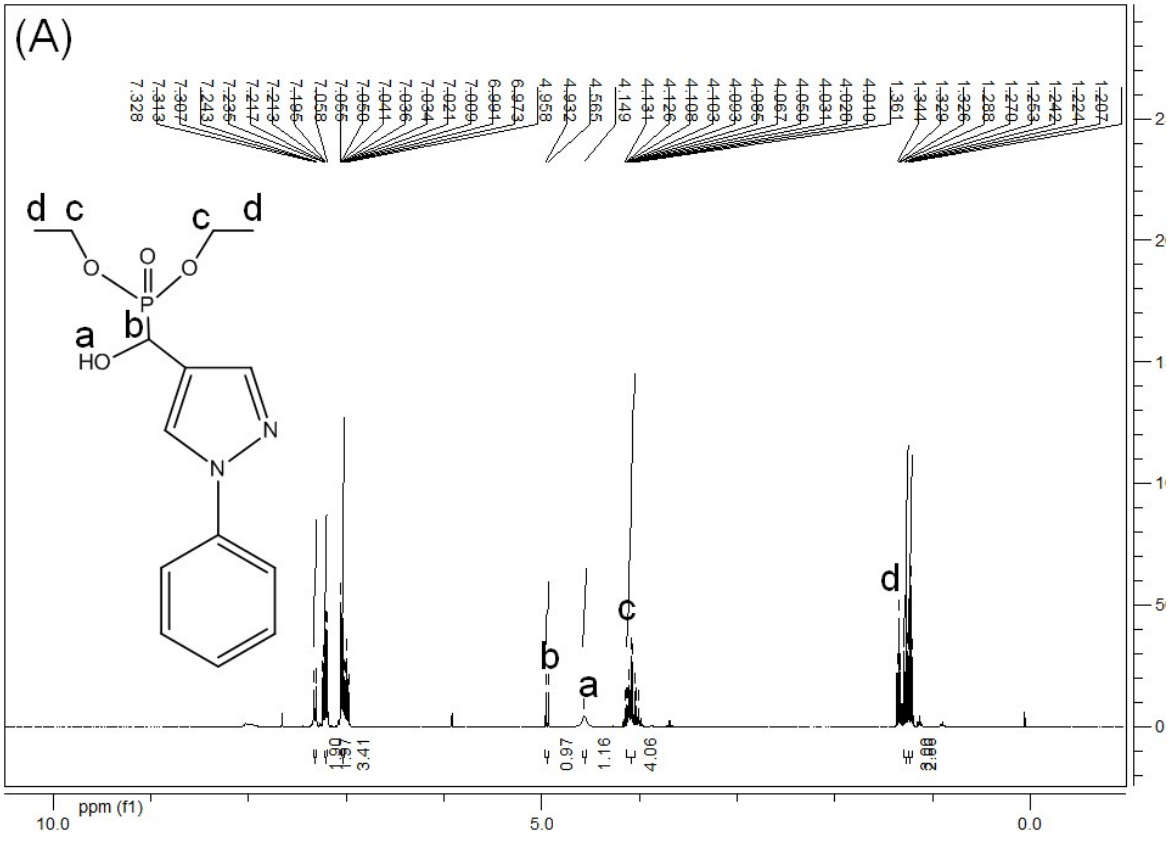


Fig. S23. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **21.**



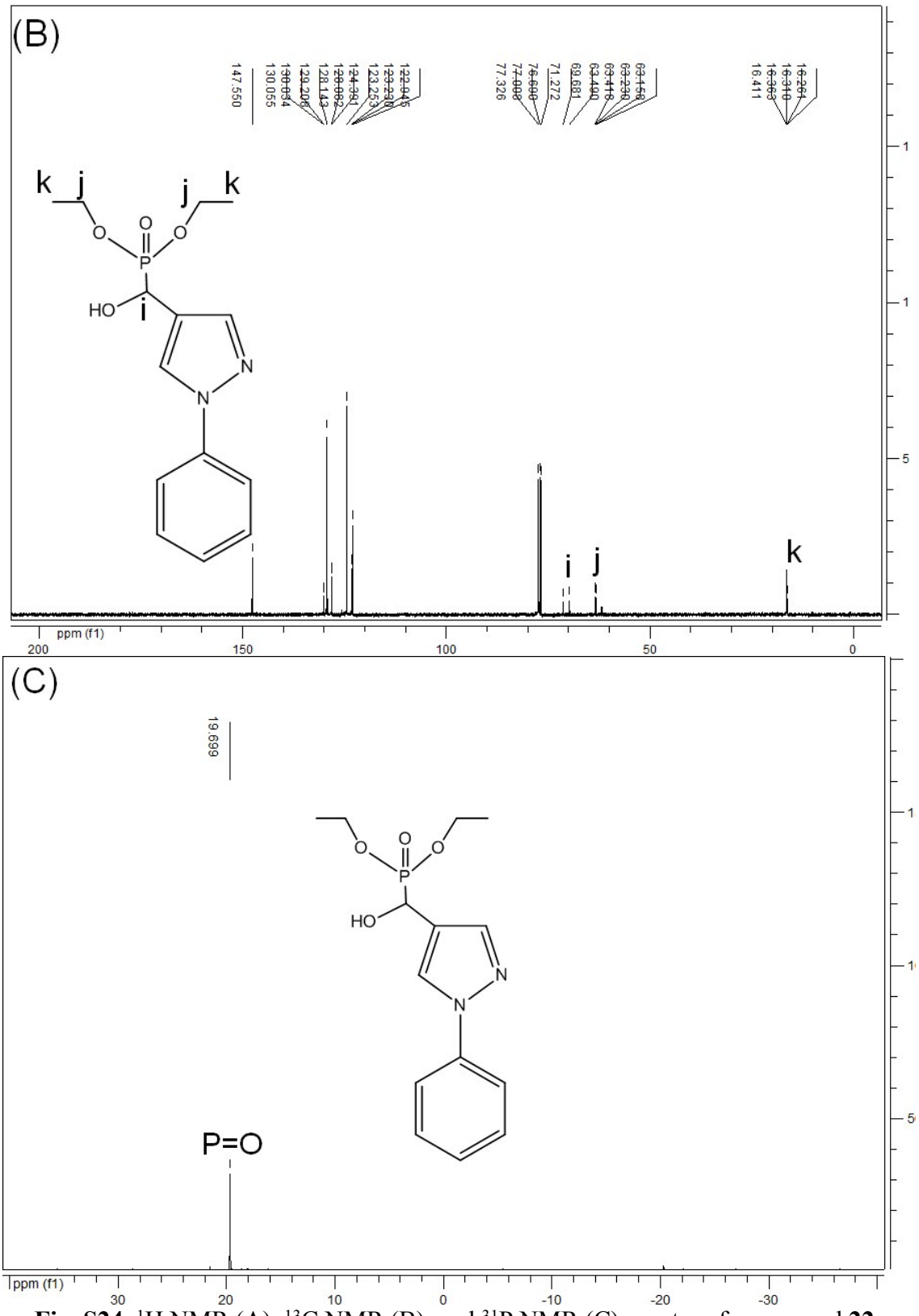


Fig. S24. ^{1}H NMR (A), ^{13}C NMR (B), and ^{31}P NMR (C) spectra of compound **22.**