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Tandem Aza Michael Addition—Vinylogous Nitroaldol Condensation: Construction of Highly Substituted *N*-Fused 3-Nitropyrazolopyridines

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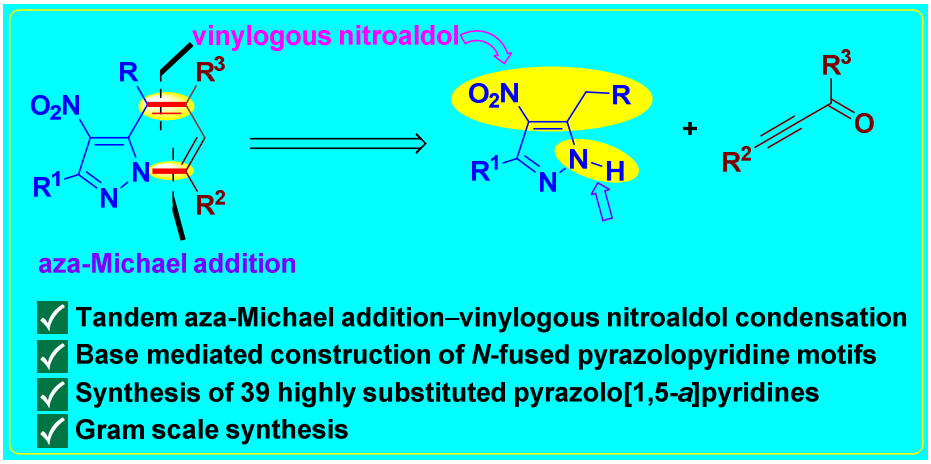


ABSTRACT: A base-mediated tandem aza-Michael addition—vinylogous nitroaldol condensation has been described between 3,5-dialkyl 4-nitropyrazoles and alkynyl ketones/aldehydes. This transition metal-free atom economical transformation occurred *via* C–N and C=C bond formations in one step with the elimination of water. The construction of a variety of highly substituted *N*-fused 3-nitro-pyrazolopyridine derivatives has been demonstrated with good yields. Good to excellent regioselectivities have been achieved with unsymmetrically substituted 4-nitropyrazoles.

INTRODUCTION

N-Fused heterocycles, essentially comprising of at least two structural *N*-heterocyclic ring motifs, have received much attention as these compounds have exhibited excellent biological activities and represent several marketed therapeutics.[1] Among them pyrazolo[1,5-*a*]pyridine derivatives have displayed a wide range of potential biological activities that may become suitable for "privileged" compounds in drug discovery research programs. Substituted *N*-fused/bridged pyrazolopyridine derivatives that possess a wide range of potential biological activities are depicted in Figure 1.[2] *Eg.* 3-Amino substituted pyrazolo[1,5-*a*]pyridine E2508 is an antagonist of Corticotropin Releasing Factor-1 (CRF_1) receptor and has been proved to possess excellent drug properties to advance into clinical trials for the treatment of stress related disorders (Figure 1).[2e] Therefore the construction of pyrazole fused pyridines has been a topic of interest to organic chemists.[3]

The reported methods to access the *N*-fused pyrazolopyridine skeleton, broadly, fall in to two strategies: (i) construction of pyrazole on a pyridine ring and (ii) construction of pyridine on a pyrazole ring (Scheme 1a,b). There have been several reports on the former strategy that use the specifically prepared pyridine reagents including *N*-aminated pyridines and 2-substituted pyridines as precursors.[4] However, these precursors are not readily accessible besides the synthesis of *N*-aminated pyridines is associated with the generation of by-products.[5] Hence the pyridine part is scarcely substituted in this strategy. The substituted pyrazolopyridine derivatives are generally synthesized using expensive/unfriendly transition metal catalysts through the functionalization/derivatization of the appropriate pyrazolo[1,5-*a*]pyridines.[6]

Concerning the later strategy, the reported methods using this strategy are very few that deal with the intramolecular cyclization of specially substituted pyrazole precursors.[7] Further these

precursors were prepared using multi-step synthesis. Intermolecular approach was reported for the synthesis of pyrazolo[1,5-*a*]pyridine derivatives from the reaction of 3-aryl substituted pyrazole-5-carbaldehydes and 4-bromocrotonates.[8] However, the pyrazole precursors were synthesized using multi-step processes.

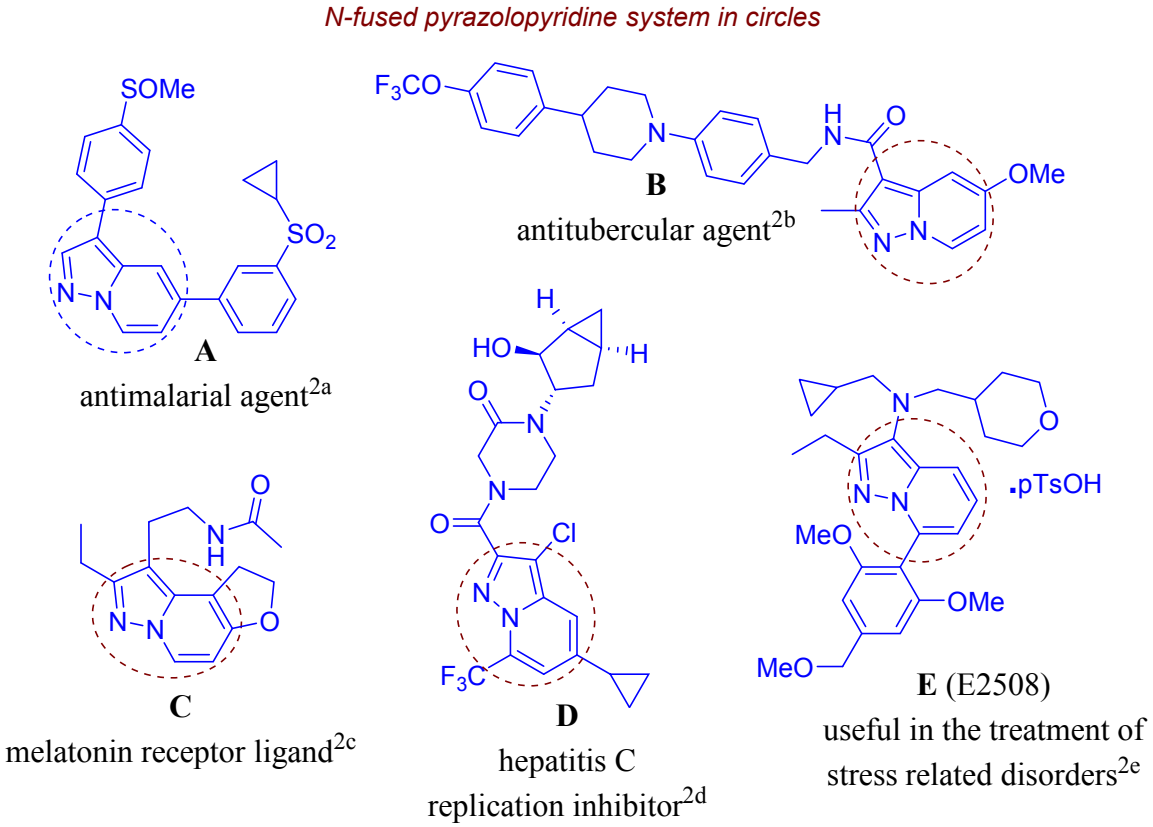


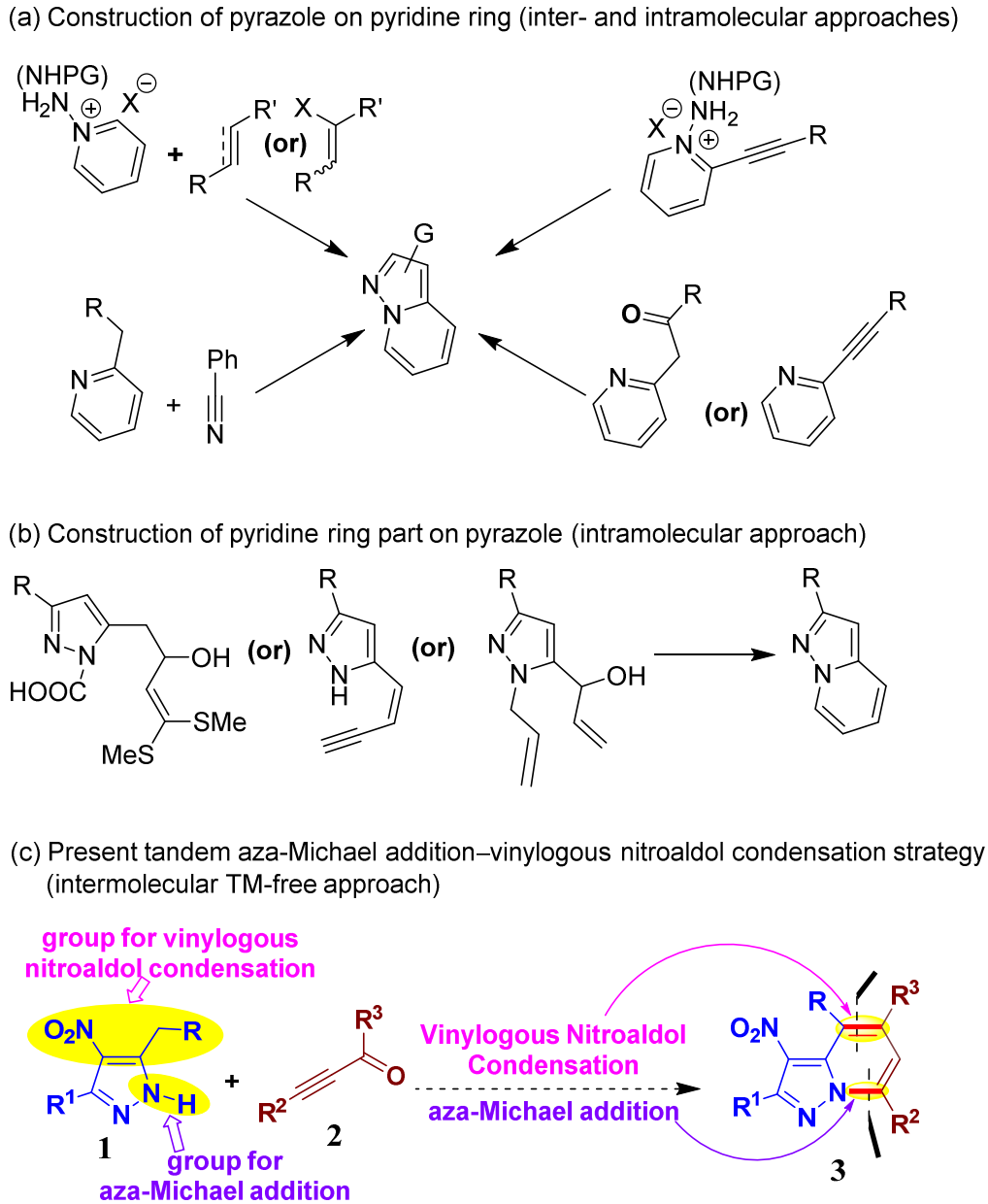
Figure 1. Selected biologically active substituted *N*-fused pyrazolopyridine derivatives.

RESULTS AND DISCUSSION

Recently, we have reported transition metal (TM)-catalyzed arylation–cyclization strategies for the synthesis of various fused heterocycles.[9] Herein, alternatively, we report the development of TM-free strategy for the synthesis of *N*-fused pyrazolopyridine derivatives. We envisaged the direct construction of pyridine ring structure on a pyrazole ring from an intermolecular reaction between 3,5-dialkyl substituted 4-nitropyrazoles **1** and alkynyl ketones/aldehydes **2**, harnessing

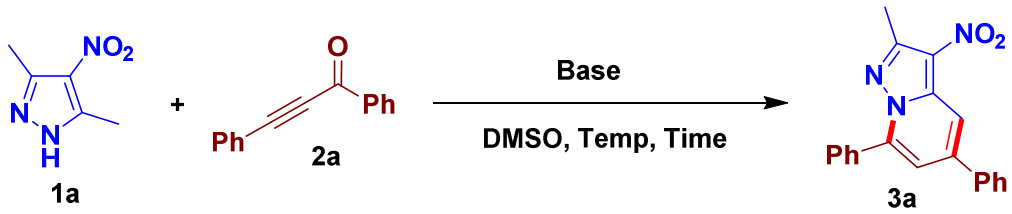
their innate reactivity profiles (Scheme 1c). The proposed strategy involves tandem aza-Michael addition of 4-nitropyrazole to alkynyl carbonyl compound followed by vinylogous nitroaldol condensation of γ-active methyl(-ene) group of 4-nitropyrazole and carbonyl group on alkyne (Scheme 1c).

Scheme 1. Strategies for the construction of *N*-fused pyrazolopyridines and Present tandem strategy.



Accordingly, we have performed the reaction of readily accessible 3,5-dimethyl-4-nitropyrazole **1a** and alkynyl ketone **2a** in the presence of different bases like KOH, KO^{t}Bu, and NaH—unfortunately, none of these reactions gave the expected product but most of the starting materials were recovered unreacted (Table 1, entries 1-3). Gratifyingly, use of potassium carbonate as a base gave excellent yields of the desired product **3a** *via* tandem aza-Michael addition—vinylogous nitroaldol condensation (Table 1, entries 4-5). We have also screened different bases (Table 1, entries 6-7), various solvents and reaction conditions in this transformation (for an extensive optimization survey, see Supporting Information). It turned out that K_2CO_3 in DMSO at 120 ^oC was found to be the best condition from the optimization survey. Note that this transformation works well at room temperature albeit required prolonged reaction time (Table 1, entry 8). This transformation was not successful in the absence of the base (Table 1, entry 9) or in the presence of a catalytic amount (20 mol%) of the base.

Table 1. Optimization study.[a]



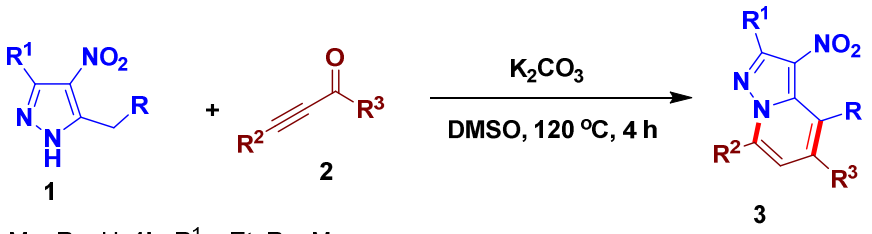
Entry	Base	Temp (^{o}C)	Time (h)	% yield of 3a
1	KOH	120	2	—
2	KO^{t}Bu	120	2	—
3	NaH	120	2	—

4	K_2CO_3	120	2	86
5	***K_2CO_3***	***120***	***4***	***92***
6	$NaHCO_3$	120	4	85
7	Cs_2CO_3	120	4	71
8	K_2CO_3	RT	24	85
9	—	120	4	—

[a] Reaction conditions: **1a** (0.5 mmol), **2a** (0.5 mmol), base (1.65 mmol), DMSO = dimethyl sulfoxide (2 mL).

After identifying the set of optimized conditions, we turned to study the generality of the present tandem aza-Michael addition—vinylogous nitroaldol condensation (Scheme 2). We have used 4-nitropyrazoles containing symmetrical alkyl groups at 3-, 5-positions and variously substituted alkynyl carbonyl compounds. Reactions of 3,5-dimethyl- and 3,5-diethyl-4-nitropyrazoles (**1a** and **1b**) with 1,3-diphenylprop-2-yn-1-one **2a** provided good to excellent yields of the corresponding pyrazolopyridine derivatives **3a-b**. Reactions with 1-(naphthalen-1-yl)-3-phenylprop-2-yn-1-one **2b** gave moderate to good yields of the pyrazolopyridines **3c-d**. Several diaryl substituted alkynyl ketones containing halogen, electron withdrawing and electron donating groups on the aryl moieties have been used in this tandem process to furnish the corresponding highly substituted pyrazolo[1,5-*a*]pyridine derivatives **3e-u** in moderate to high yields. The reaction of **1a** and 1,1,1-trifluoro-4-phenylbut-3-yn-2-one **2p** afforded the corresponding pyrazole fused pyridine **3v** in 42% yield. The reactions of 3,5-dialkyl 4-nitropyrazoles **1a-b** and alkynyl ketones **2q-r** having aryl, alky substituents provided good yields of the corresponding *N*-fused pyrazolopyridines **3w-y**. The reaction of **1a** and hex-3-yn-2-one **2s** afforded the corresponding pyrazole fused pyridine **3z** in 53% yield.

Scheme 2. Reaction of 3,5-dimethyl- and 3,5-diethyl-4-nitropyrazoles and alkynyl ketones.[a]



1a: R^1 = Me, R = H; **1b**: R^1 = Et, R = Me

2a: R^2, R^3 = Ph; **2b**: R^2 = Ph, R^3 = 1-Naph; **2c**: R^2 = C_6H_4-*p*-Ph, R^3 = Ph; **2d**: R^2 = Ph, R^3 = C_6H_4-*p*-Cl; **2e**: R^2 = Ph, R^3 = C_6H_4-*o*-Cl; **2f**: R^2 = Ph, R^3 = C_6H_4-*m*-NO_2; **2g**: R^2 = Ph, R^3 = C_6H_4-*p*-OMe; **2h**: R^2 = C_6H_4-*p*-F, R^3 = Ph; **2i**: R^2 = C_6H_4-*p*-Cl, R^3 = Ph; **2j**: R^2 = C_6H_4-*o*-Cl, R^3 = Ph; **2k**: R^2 = C_6H_4-*p*-Me, R^3 = Ph; **2l**: R^2 = C_6H_4-*p*-^{t}Bu, R^3 = Ph; **2m**: R^2 = C_6H_4-*p*-F, R^3 = C_6H_4-*p*-OMe; **2n**: R^2 = C_6H_4-*p*-Me, R^3 = C_6H_4-*m*-NO_2; **2o**: R^2 = C_6H_4-*p*-^{t}Bu, R^3 = C_6H_4-*m*-NO_2; **2p**: R^2 = Ph, R^3 = CF_3; **2q**: R^2 = Ph, R^3 = ^{t}Bu; **2r**: R^2 = C_6H_4-*p*-^{t}Bu, R^3 = ^{t}Bu; **2s**: R^2 = Et, R^3 = Me

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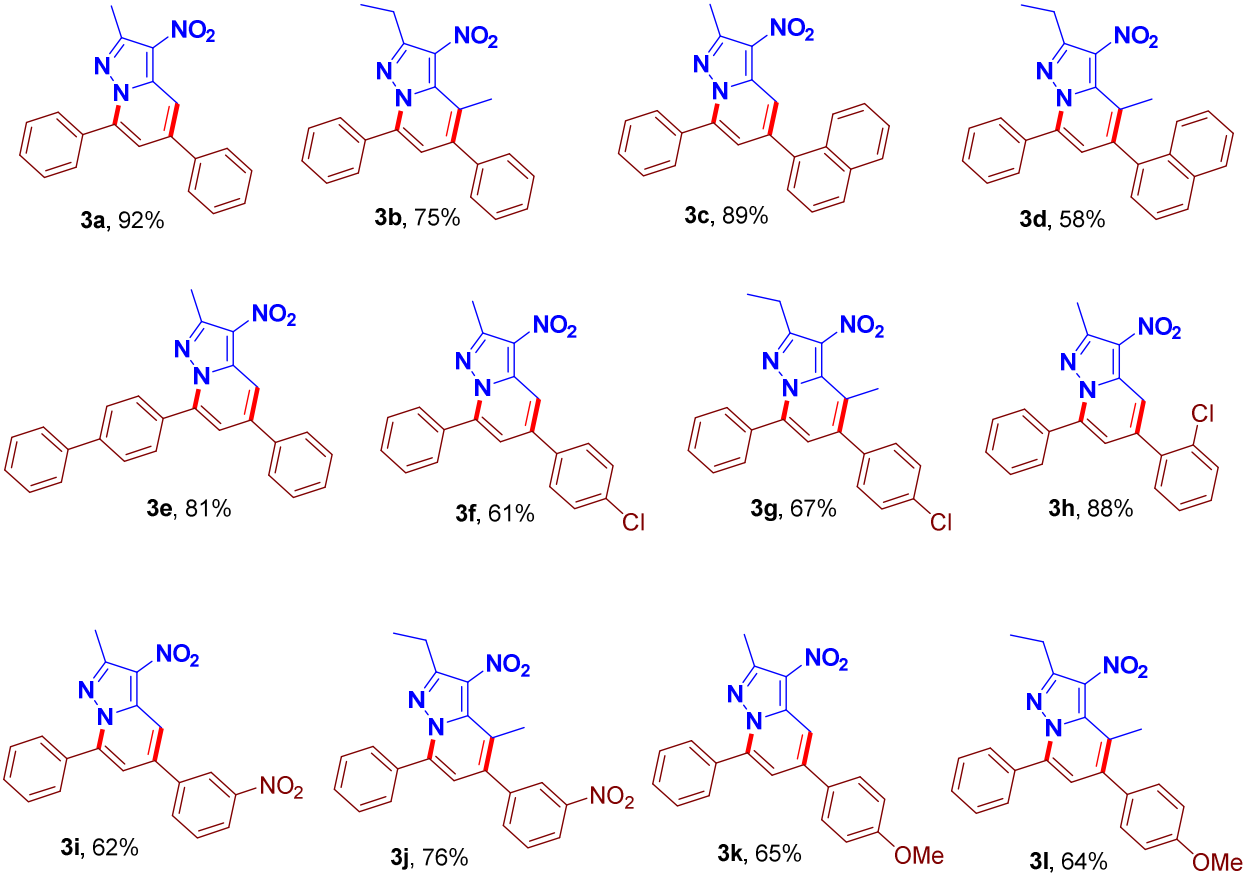
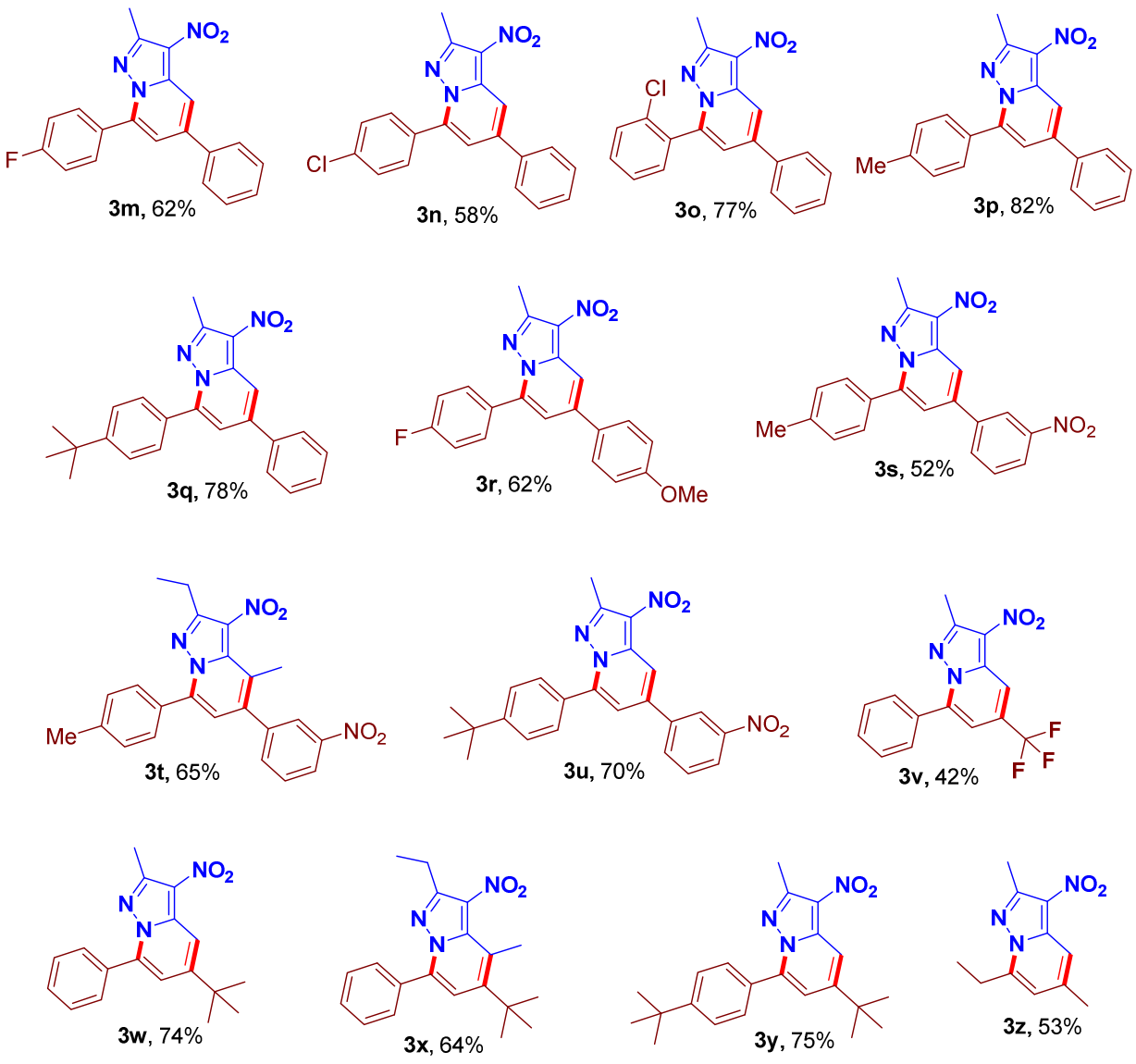


3a, 92% **3b**, 75% **3c**, 89% **3d**, 58%

3e, 81% **3f**, 61% **3g**, 67% **3h**, 88%

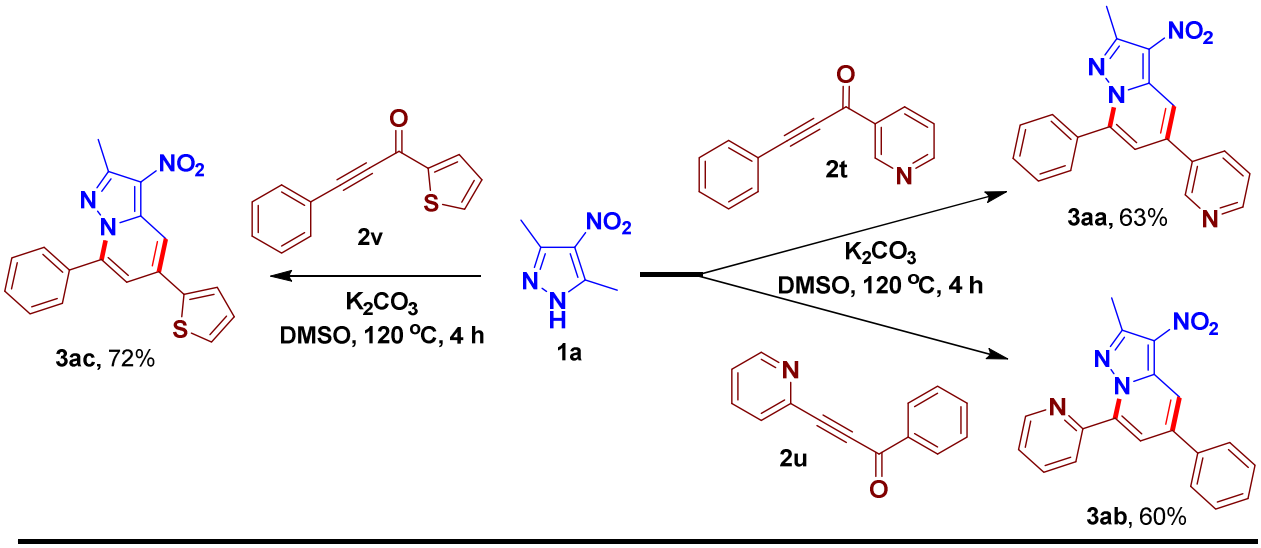
3i, 62% **3j**, 76% **3k**, 65% **3l**, 64%



[a] Reaction conditions: **1** (0.5 mmol), **2** (0.5 mmol), K_2CO_3 (1.65 mmol), DMSO (2 mL).

We have also used alkynyl ketones **2t-v**—containing heteroaryl moieties like 2-, 3-pyridyl and 2-thiophenyl—in the tandem aza-Michael addition—vinylogous nitroaldol condensation process of 3,5-dimethyl-4-nitropyrazole **1a** to furnish the corresponding pyrazolo[1,5-*a*]pyridines **3aa-ac** in good yields (Scheme 3).

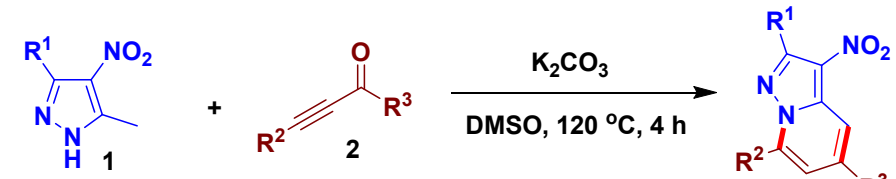
Scheme 3. Reaction of 3,5-dimethyl-4-nitropyrazole and alkynyl ketones bearing heterocycles.[a]



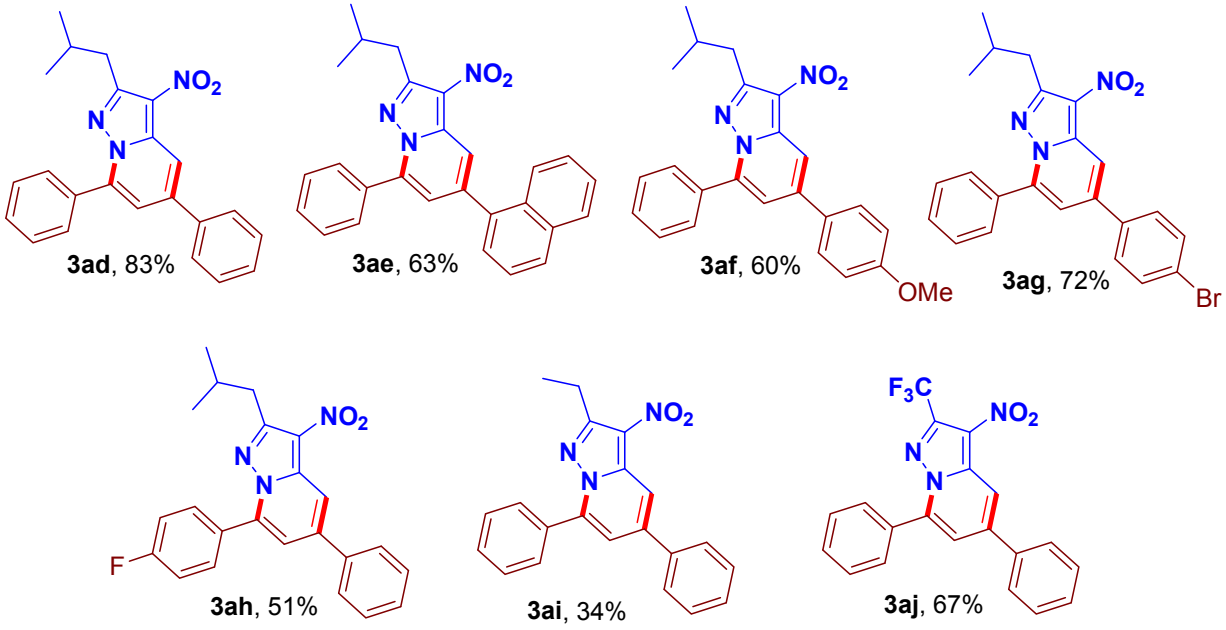
[a] Reaction conditions: **1** (0.5 mmol), **2** (0.5 mmol), K_2CO_3 (1.65 mmol), DMSO (2 mL).

Later we checked the scope of the present tandem reaction using 4-nitropyrazoles **1c-e** containing unsymmetrical alkyl groups at 3-, 5-positions and variously substituted alkynyl carbonyl compounds **2a-b**, **2g-h**, **2w** (Scheme 4). The corresponding pyrazolo[1,5-*a*]pyridines **3ad-3aj** were isolated in moderate to very good yields. It is interesting to note that the products **3ad-3ai** were isolated with excellent regioselectivity resulting from the participation of less sterically hindered methyl group at 5-position of the pyrazole in the vinylogous nitroaldol condensation process.

Scheme 4. Reaction of unsymmetrical 3,5-disubstituted 4-nitropyrazoles and alkynyl ketones.[a]



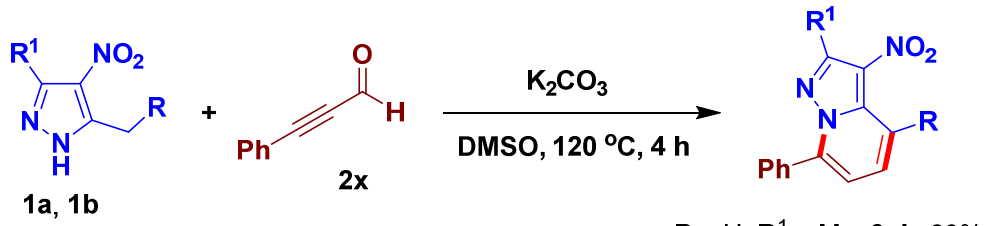
1c: $R^1 = CH_2CHMe_2$; **1d**: R^1 = Et; **1e**: $R^1 = CF_3$
2w: R^2 = Ph, $R^3 = C_6H_4$-*p*-Br



[a] Reaction conditions: **1** (0.5 mmol), **2** (0.5 mmol), K_2CO_3 (1.65 mmol), DMSO (2 mL).

We have also used alkynyl aldehydes like 3-phenylpropiolaldehyde **2x** in the tandem aza-Michael addition—vinylogous nitroaldol condensation process of 3,5-dimethyl- and 3,5-diethyl-4-nitropyrazoles **1a-b** to furnish the corresponding pyrazolo[1,5-*a*]pyridines **3ak** and **3al** in 63% and 55% yields, respectively (Scheme 5).

Scheme 5. Reaction of 1a-b and 2x.[a]

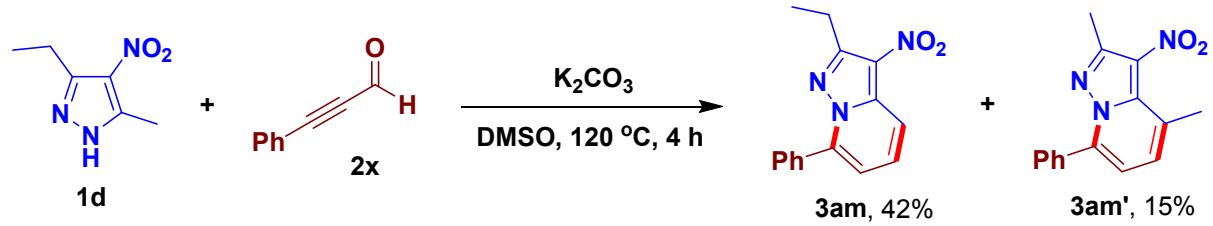


R = H, R^1 = Me; **3ak**, 63%
R = Me, R^1 = Et; **3al**, 55%

[a] Reaction conditions: **1** (0.5 mmol), **2x** (0.5 mmol), K_2CO_3 (1.65 mmol), DMSO (2 mL).

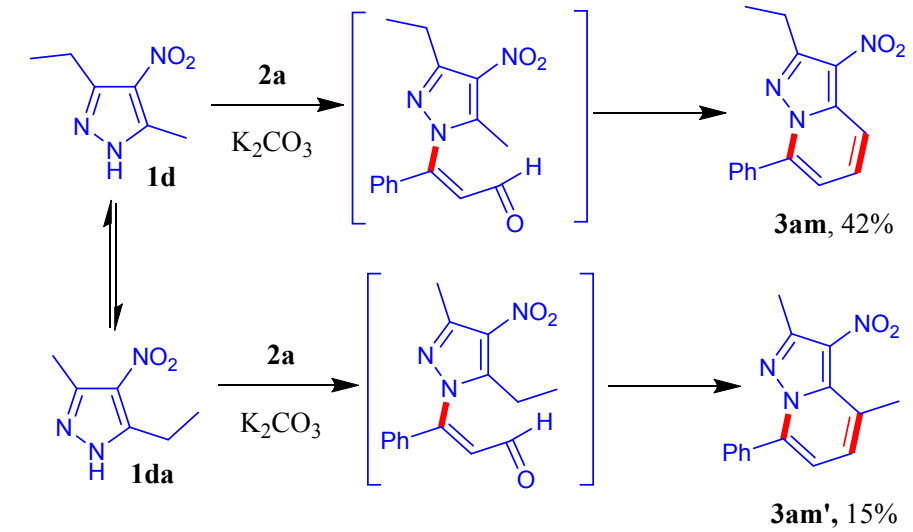
When the unsymmetrical 3-ethyl-5-methyl-4-nitro-1*H*-pyrazole **1d** and 3-phenylpropiolaldehyde **2x** reacted, two regioisomers **3am** and **3am'** were obtained in 3:1 ratio, respectively (Scheme 6a). It is reasonable to believe that the formation of isomer **3am'** resulted from the tautomerization of 3-ethyl-5-methyl-4-nitro-1*H*-pyrazole **1d** to 5-ethyl-3-methyl-4-nitro-1*H*-pyrazole **1da**.[10] The major product being resulted from the participation of less sterically congested 5-methyl substituent of **1d** in the vinylogous nitroaldol condensation process (Scheme 6b).

Scheme 6. Reaction of 1d and 2x.[a]



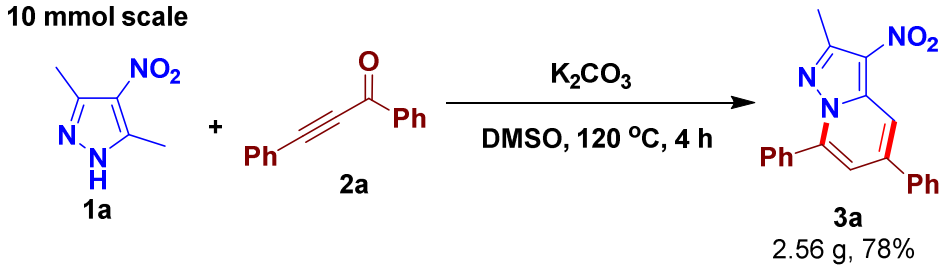
[a] Reaction conditions: **1d** (0.5 mmol), **2x** (0.5 mmol), K_2CO_3 (1.65 mmol), DMSO (2 mL).

Scheme 6b.



It is worth mentioning that the present tandem aza-Michael addition—vinylogous nitroaldol condensation process worked well at gram scale to provide 2-methyl-3-nitro-5,7-diphenylpyrazolo[1,5-a]pyridine **3a** in high yield (Scheme 7).

Scheme 7. Gram scale synthesis of product 3a.[a]

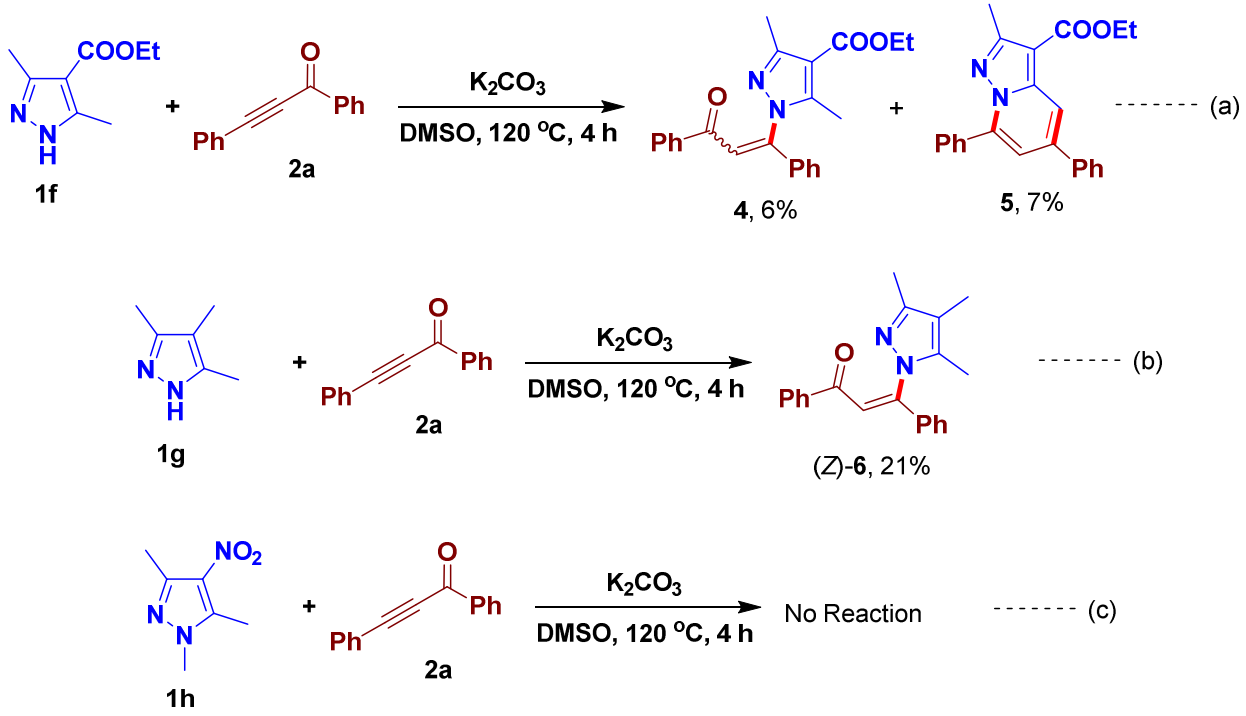


[a] Reaction conditions: **1a** (10 mmol), **2a** (10 mmol), K_2CO_3 (33 mmol), DMSO (25 mL).

We became interested to test carboxylate as an electron withdrawing group instead of nitro group at the 4-position of 3,5-dimethylpyrazole. Accordingly, the reaction of ethyl 3,5-dimethyl-

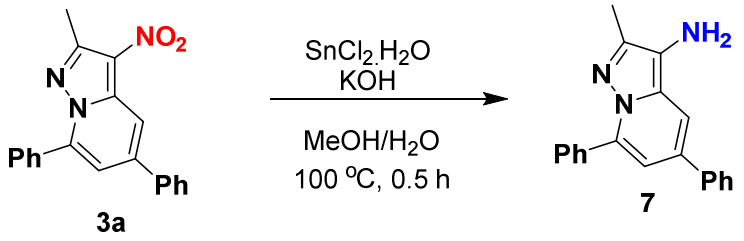
1*H*-pyrazole-4-carboxylate **1f** and 1,3-diphenylprop-2-yn-1-one **2a** was conducted in the presence of K_2CO_3 in DMSO at 120 °C for 4 h. We have observed the formation of the corresponding aza-Michael adduct **4** and pyrazolo[1,5-*a*]pyridine **5** in very low yields (Scheme 8a) . The reaction of 3,4,5-trimethyl-1*H*-pyrazole **1g**, having methyl group at 4-position, and **2a** was conducted in DMSO in the presence of K_2CO_3. In this reaction the corresponding aza-Michael adduct **6** was observed in low yield (Scheme 8b). The above experiments suggest that the present tandem process is more efficient with strong EWG like nitro group at the 4th position on pyrazole. The reaction of *N*-methyl substituted 3,5-dimethyl-4-nitropyrazole **1h** and **2a** was not successful to give any vinylogous nitroaldol condensation product while most of the pyrazole remain unreacted (Scheme 8c).

Scheme 8. Reactions of 1f-h and 2a.



The 3-nitro group of the pyrazolo[1,5-*a*]pyridine **3a** was reduced to give the corresponding 3-amino pyrazolo[1,5-*a*]pyridine **7** derivative in good yield without further purification. The reaction was also conducted on gram scale to give moderate yield of the product **7** (Scheme 9).

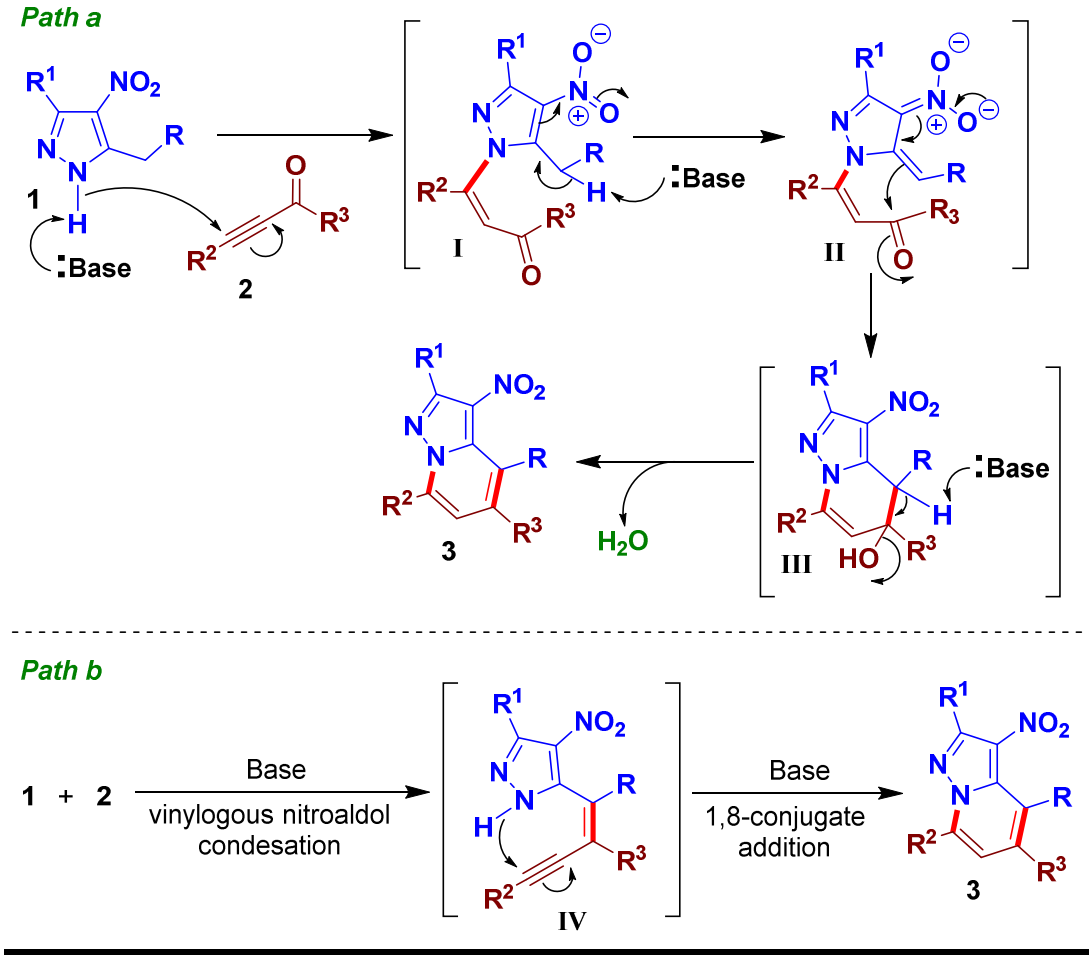
Scheme 9. Reduction of nitro group in 3a.



1 mmol scale: 0.21 g, 72%
10 mmol scale: 1.70 g, 57%

A plausible tentative mechanism can be proposed for the present tandem aza-Michael addition—vinylogous nitroaldol condensation. In the presence of base 3,5-dialkyl 4-nitropyrazole **1** would add on to the alkynyl carbonyl compound **2** in aza-Michael addition fashion to give intermediate **I**. The base would abstract the acidic proton present on the active γ-methylene group, activated by a nitro group through conjugation, to provide intermediate **II** that can act as a *C*-nucleophile. The vinylogous nitroaldol condensation process would finally give the product **3** *via* intermediate **III** with the loss of a water molecule (Scheme 10, path a). Alternatively, the reaction may go through initial vinylogous nitroaldol condensation intermediate **IV** followed by intramolecular 1,8-conjugate addition (Scheme 10, path b). However, this path may be ruled out since the reaction of 1,3,5-trimethyl-4-nitro-1*H*-pyrazole **1h** did not provide a vinylogous nitroaldol condensation product.

Scheme 10. Plausible reaction mechanism.



CONCLUSIONS

In summary, we have developed and demonstrated a new tandem reaction process involving base-mediated aza Michael addition—vinylogous nitroaldol condensation process between 3,5-dialkyl substituted 4-nitropyrazoles and alkynyl aldehydes or ketones. The advantages of this transformation being the formation of C–N and C=C bonds in one step and atom economic with the generation of water as the only by-product. This process furnished highly substituted 3-nitropyrazolo[1,5-*a*]pyridine derivatives in moderate to high yields. Further studies are underway on the application of the developed method for selected target oriented synthesis.

EXPERIMENTAL SECTION

All the reactions were performed using oven-dried standard glassware or screw-caped vials. The reactions are stirred magnetically and monitored by analytical thin layer chromatography (TLC). TLC was made by silica gel 60 F_{254}, and UV lamp was used as visualizing agent. Iodine, 5% aqueous potassium permanganate solution were used as a developing agents followed by heating. Purification of products was performed using column chromatography on silica gel (60-120, 100-120 and 230-400 mesh) where it is required. Hexane/ethyl acetate were used as eluents. The solvents were removed by rotary evaporator at 40-45 ^{o}C under reduced pressure. All the reagents and solvents were purchased from commercial suppliers. Melting points reported in this work are uncorrected. The IR spectra were recorded on a FT-IR spectrophotometer by dissolving the sample in chloroform or as KBr pellet. ^{1}H-NMR spectra were recorded on 300, 400 and 500 MHz instruments. Chemical shifts (δ) are reported in parts per million (ppm) with the reference solvent and the internal standards (TMS = 0; $CDCl_3$ = 7.26). The following abbreviations were used to explain the multiplicity of the spectra (s = singlet, d = doublet, dd = doublet of doublet, t = triplet, q = quartet, sep = septet, m = multiplet). ^{13}**C-NMR** spectra were recorded on 75, 100, and 125 MHz spectrometers. The mass spectral analyses were carried out using Electrospray Ionization (ESI) techniques and high resolution mass spectra (HRMS) were recorded on a Orbitrap Mass Spectrometer or QSTAR XL Hybrid MS/MS mass spectrometer.

General procedure for the synthesis of pyrazolo[1,5-*a*]pyridine derivatives (0.5 mmol scale) 3a-3am':- 3,5-Dialkyl 4-nitro-1*H*-pyrazole **1** (0.5 mmol), K_2CO_3 (1.65 mmol, 227 mg), alkynyl carbonyl compound **2** (0.5 mmol) were taken into a 10 mL screw cap vial and added DMSO (2 mL). The reaction vial was placed in a metal heating block, gradually heated to 120 ^{o}C

and stirred at the same temperature for 4 h. The reaction mixture was cooled to room temperature, diluted with water and extracted with ethyl acetate (2 x 20 mL). The organic phase was washed with brine, dried over anhydrous Na_2SO_4 and filtered. The solvent was removed in *vacuo* to afford a crude residue. The residue was purified by flash column chromatography (hexane/EtOAc, 95:5) on silica gel to afford pyrazolo[1,5-*a*]pyridine derivatives **3a-3am'**.

2-Methyl-3-nitro-5,7-diphenylpyrazolo[1,5-*a*]pyridine 3a:- Pale yellow solid, 152 mg, (0.462 mmol), 92%, R_f = 0.6 (EtOAc/Hexane, 5:95); **MP** 158-160 ^oC; **IR** ($CHCl_3$) 741, 928, 1214, 1476, 1549, 1635, 3019 cm^{-1}; **^{1}H-NMR** (400 MHz, $CDCl_3$) δ = 2.78 (s, 3H), 7.40 (d, *J* = 2.0 Hz, 1H), 7.48-7.51 (m, 1H), 7.52-7.55 (m, 2H), 7.55-7.60 (m, 3H), 7.77-7.79 (m, 2H), 7.88-7.91 (m, 2H), 8.57 (d, *J* = 2.0 Hz, 1H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 14.9, 114.0, 115.8, 127.3, 128.7, 129.3, 129.5, 129.7, 130.5, 131.7, 137.4, 138.8, 141.6, 144.2, 151.9; **MS** (ESI) m/z 330 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{20}H_{16}N_3O_2$ $[M+H]^+$ 330.1237, found 330.1239.

2-Ethyl-4-methyl-3-nitro-5,7-diphenylpyrazolo[1,5-*a*]pyridine 3b:- Pale yellow solid, 134 mg, (0.375 mmol), 75%, R_f = 0.6 (EtOAc/Hexane, 5:95); **MP** 118-120 ^oC; **IR** ($CHCl_3$) 747, 1214, 1471, 1526, 2921, 3020 cm^{-1}; **^{1}H-NMR** (400 MHz, $CDCl_3$) δ = 1.36 (t, *J* = 7.4 Hz, 3H), 2.53 (s, 3H), 3.10 (q, *J* = 7.5 Hz, 2H), 7.08 (s, 1H), 7.40-7.45 (m, 2H), 7.46-7.49 (m, 2H), 7.49-7.55 (m, 4H), 7.85-7.89 (m, 2H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 12.6, 18.3, 21.8, 118.4, 124.1, 125.5, 128.4, 128.5, 128.7, 129.3, 129.7, 129.9, 132.1, 137.7, 138.6, 138.8, 143.9, 156.1; **MS** (ESI) m/z 358 $[M+H]^+$; **HRMS** (ESI, m/z):calcd for $C_{22}H_{20}N_3O_2$ $[M+H]^+$ 358.1550, found 358.1557.

2-Methyl-5-(naphthalen-1-yl)-3-nitro-7-phenylpyrazolo[1,5-*a*]pyridine 3c:- Yellow solid, 169 mg, (0.445 mmol), 89%, R_f = 0.5 (EtOAc/Hexane, 10:90); **MP** 168-170 ^oC; **IR** ($CHCl_3$) 758, 1157, 1380, 1477, 1549, 1636, 2853, 2923, 3058 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ =

2.80 (s, 3H), 7.54 (s, 1H), 7.56-7.62 (m, 5H), 7.87-7.99 (m, 5H), 8.01 (d, *J* = 8.6 Hz, 1H), 8.26 (s, 1H), 8.70 (s, 1H); **^{13}C{1H}NMR** (125 MHz, $CDCl_3$) δ = 14.9, 114.2, 115.9, 123.7, 124.5, 126.9, 127.0, 127.2, 127.8, 128.6, 128.7, 129.2, 129.8, 130.5, 131.8, 133.5, 133.6, 134.6, 138.8, 141.7, 144.1, 151.9; **MS** (ESI) m/z 380 $[M+H]^+$ **HRMS** (ESI, m/z): calcd for $C_{24}H_{18}N_3O_2$ $[M+H]^+$, 380.1393 found 380.1402.

2-Ethyl-4-methyl-5-(naphthalen-1-yl)-3-nitro-7-phenylpyrazolo[1,5-*a*]pyridine 3d:- Yellow solid, 118 mg, (0.289 mmol), 58%, R_f = 0.5 (EtOAc/Hexane, 10:90); **MP** 160-162 ^{o}C; **IR** ($CHCl_3$) 751, 1214, 1463, 1666, 2853, 2923, 2955, 3019 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 1.38 (t, *J* = 7.5 Hz, 3H), 2.58 (s, 3H), 3.12 (q, *J* = 7.5 Hz, 2H), 7.18 (s, 1H), 7.51-7.58 (m, 6H), 7.88-7.94 (m, 5H), 7.97 (d, *J* = 8.4 Hz, 1H); **^{13}C{1H}NMR** (125 MHz, $CDCl_3$) δ = 12.6, 17.9, 21.8, 119.0, 125.3, 125.9, 126.3, 126.8, 126.9, 128.4, 128.6, 128.8, 129.7, 129.9, 131.2, 131.9, 133.6, 136.5, 137.4, 138.4, 142.4, 155.9; **MS** (ESI) m/z 408 $[M+H]^+$ **HRMS** (ESI, m/z): calcd for $C_{26}H_{22}N_3O_2$ $[M+H]^+$ 408.1712 found 408.1707.

7-([1,1'-Biphenyl]-4-yl)-2-methyl-3-nitro-5-phenylpyrazolo[1,5-*a*]pyridine 3e:- yellow solid, 164 mg, (0.404 mmol), 81%, R_f = 0.6 (EtOAc/Hexane, 30:70); **MP** 234-236 ^{o}C; **IR** ($CHCl_3$) 763, 1286, 1474, 1546, 1632, 2855, 2922 cm^{-1}; **^{1}H-NMR** (400 MHz, $CDCl_3$) δ = 2.81 (s, 3H), 7.39-7.57 (m, 7H), 7.67-7.69 (m, 2H), 7.78-7.80 (m, 4H), 7.99-8.01 (m, 2H), 8.57 (d, *J* = 2.0 Hz, 1H); **^{13}C{1H}NMR** (125 MHz, $CDCl_3$) δ = 14.9, 113.9, 115.7, 127.2, 127.3, 127.4, 129.0, 129.4, 130.2, 137.3, 138.8, 140.1, 141.3, 143.4, 144.2, 151.9; **MS** (ESI) m/z 406 $[M+H]^+$ **HRMS** (ESI, m/z):calcd for $C_{26}H_{20}N_3O_2$ $[M+H]^+$ 406.1550, found 406.1559.

5-(4-Chlorophenyl)-2-methyl-3-nitro-7-phenylpyrazolo[1,5-*a*]pyridine 3f:- Pale yellow solid, 110 mg, (0.303 mmol), 61%, R_f = 0.5 (EtOAc/Hexane, 5:95); **MP** 172-174 ^{o}C; **IR** ($CHCl_3$) 756, 1161, 1471, 1548, 1635, 2923, 3061 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 2.78 (s, 3H),

7.34 (d, *J* = 2.0 Hz, 1H), 7.50-7.52 (m, 2H), 7.57-7.58 (m, 3H), 7.71-7.72 (m, 2H), 7.88-7.90 (m, 2H), 8.53 (d, *J* = 2.0 Hz, 1H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 14.9, 113.9, 115.4, 128.6, 128.7, 129.6, 129.7, 130.6, 131.6, 135.8, 135.9, 138.7, 141.8, 142.8, 152.1; **MS** (ESI) m/z 364 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{20}H_{15}N_3O_2Cl$ $[M+H]^+$ 364.0847, found 364.0846.

5-(4-Chlorophenyl)-2-ethyl-4-methyl-3-nitro-7-phenylpyrazolo[1,5-*a*]pyridine 3g:- Pale yellow solid, 131 mg, (0.335 mmol), 67%, R_f = 0.5 (EtOAc/Hexane, 5:95); **MP** 166-168 ^oC; **IR** ($CHCl_3$) 764, 1198, 1473, 1532, 1612, 2932, 2973 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 1.34 (t, *J* = 7.5 Hz, 3H), 2.51 (s, 3H), 3.10 (q, *J* = 7.5 Hz, 2H), 7.02 (s, 1H), 7.34-7.37 (m, 2H), 7.46-7.49 (m, 2H), 7.51-7.54 (m, 3H), 7.83-7.87 (m, 2H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 12.5, 18.3, 21.8, 117.9, 124.1, 125.6, 128.4, 128.9, 129.7, 130.0, 130.6, 131.9, 134.6, 137.2, 137.6, 138.8, 142.6, 156.1; **MS** (ESI) m/z 392 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{22}H_{19}N_3O_2Cl$ $[M+H]^+$ 392.1160, found 392.1162.

5-(2-Chlorophenyl)-2-methyl-3-nitro-7-phenylpyrazolo[1,5-*a*]pyridine 3h:- Yellow solid, 160 mg, (0.44 mmol), 88%, R_f = 0.34 (EtOAc/Hexane, 10:90); **MP** 148-150 ^oC; **IR** ($CHCl_3$) 753, 1160, 1292, 1334, 1407, 1544, 1634, 2923, 3056 cm^{-1}; **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 2.79 (s, 3H), 7.31 (d, *J* = 1.9 Hz, 1H), 7.40-7.42 (m, 2H), 7.48-7.51 (m, 1H), 7.53-7.57 (m, 4H), 7.89-7.91 (m, 2H), 8.40 (d, *J* = 1.9 Hz, 1H); **^{13}C{1H}NMR** (125 MHz, $CDCl_3$) δ = 14.9, 117.0, 118.2, 123.8, 127.4, 128.6, 129.7, 130.2, 130.3, 130.4, 131.0, 131.5, 132.3, 137.2, 138.3, 140.6, 142.6, 151.7; **MS** (ESI) m/z 364 $[M+H]^+$; **HRMS** (ESI, m/z):calcd for $C_{20}H_{15}ClN_3O_2$ $[M+H]^+$ 364.0847, found 364.0871.

2-Methyl-3-nitro-5-(3-nitrophenyl)-7-phenylpyrazolo[1,5-*a*]pyridine 3i:- Pale yellow solid, 116 mg, (0.310 mmol), 62%, R_f = 0.5 (EtOAc/Hexane, 5:95); **MP** 176-178 ^oC; **IR** ($CHCl_3$) 742, 981, 1283, 1449, 1527, 1634, 2928 cm^{-1}; **^{1}H-NMR** (400 MHz, $CDCl_3$) δ = 2.80 (s, 3H),

7.40 (d, *J* = 2.0 Hz, 1H), 7.58-7.63 (m, 3H), 7.76 (t, *J* = 8.0 Hz, 1H), 7.89-7.94 (m, 2H), 8.14 (d, *J* = 8.4 Hz, 1H), 8.36 (dd, J_1 = 2.4 Hz, J_2 = 7.6 Hz, 1H), 8.62 (d, *J* = 2.0 Hz, 2H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 14.9, 114.6, 115.1, 122.2, 124.1, 128.8, 129.7, 130.5, 130.8, 131.3, 133.2, 138.6, 139.2, 141.2, 142.2, 148.9, 152.2; **MS** (ESI) m/z 375 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{20}H_{14}N_4O_4Na$ $[M+Na]^+$; 397.0907, found 397.0932.

2-Ethyl-4-methyl-3-nitro-5-(3-nitrophenyl)-7-phenylpyrazolo[1,5-*a*]pyridine 3j:- Pale yellow solid, 153 mg, (0.379 mmol), 76%, R_f = 0.5 (EtOAc/Hexane, 5:95); **MP** 170-172 ^oC; **IR** ($CHCl_3$) 774, 1125, 1484, 1533, 1617, 2930, 3058 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 1.36 (t, *J* = 7.5 Hz, 3H), 2.53 (s, 3H), 3.11 (q, *J* = 7.5 Hz, 2H), 7.05 (s, 1H), 7.53-7.56 (m, 3H), 7.70 (t, *J* = 7.8 Hz, 1H), 7.76-7.78 (m, 1H), 7.85-7.88 (m, 2H), 8.30-8.34 (m, 2H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 12.5, 18.3, 21.8, 117.5, 123.3, 124.2, 124.4, 125.8, 128.6, 129.7, 129.8, 130.3, 131.7, 135.4, 139.2, 140.6, 140.9, 148.4, 156.3; **MS** (ESI) m/z 403 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{22}H_{19}N_4O_4$ $[M+H]^+$ 403.1400, found 403.1399; $C_{22}H_{18}N_4O_4Na$ $[M+Na]^+$ 425.1220, found 425.1218.

5-(4-Methoxyphenyl)-2-methyl-3-nitro-7-phenylpyrazolo[1,5-*a*]pyridine 3k:- Yellow solid, 117 mg, (0.325 mmol), 65%, R_f = 0.5 (EtOAc/Hexane, 10:90); **MP** 190-192 ^oC; **IR** ($CHCl_3$) 744, 1214, 1380, 1448, 1606, 3019 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 2.77 (s, 3H), 3.89 (s, 3H), 7.02-7.07 (m, 2H), 7.36 (d, *J* = 2.1 Hz, 1H), 7.55-7.60 (m, 3H), 7.70-7.76 (m, 2H), 7.84-7.91 (m, 2H), 8.16 (d, *J* = 1.9 Hz, 1H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 14.9, 55.5, 113.0, 114.7, 115.4, 128.6, 128.7, 129.7, 130.4, 131.8, 138.9, 141.5, 143.8, 151.9, 160.9; **MS** (ESI) m/z 360 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{21}H_{18}N_3O_3$ $[M+H]^+$ 360.1342 found 360.1349.

2-Ethyl-5-(4-methoxyphenyl)-4-methyl-3-nitro-7-phenylpyrazolo[1,5-*a*]pyridine 3l:- Yellow solid, 124 mg, (0.320 mmol), 64%, R_f = 0.5 (EtOAc/Hexane, 10:90); **MP** 176-178 ^oC; **IR** ($CHCl_3$) 758, 1029, 1252, 1478, 1511, 1599, 2925 cm^{-1}; **^{1}H-NMR** (400 MHz, $CDCl_3$) δ = 1.36 (t, *J* = 7.5 Hz, 3H), 2.53 (s, 3H), 3.10 (q, *J* = 7.4 Hz, 2H), 3.88 (s, 3H), 7.02 (d, *J* = 8.4 Hz, 2H), 7.07 (s, 1H), 7.36 (d, *J* = 8.4 Hz, 2H), 7.49-7.54 (m, 3H), 7.82-7.90 (m, 2H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 12.6, 18.3, 21.6, 55.3, 114.0, 118.5, 123.9, 125.3, 128.4, 129.7, 129.9, 130.6, 131.0, 132.1, 137.8, 138.5, 143.5, 156.0, 159.6, 159.7; **MS** (ESI) m/z 388 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{23}H_{22}N_3O_3$ $[M+H]^+$ 388.1655 found 388.1659.

7-(4-Fluorophenyl)-2-methyl-3-nitro-5-phenylpyrazolo[1,5-*a*]pyridine 3m:- Yellow solid, 108 mg, (0.311 mmol), 62%, R_f = 0.5 (EtOAc/Hexane, 10:90); **MP** 188-190 ^oC; **IR** ($CHCl_3$) 768, 1159, 1379, 1477, 1549, 1635, 2852, 2925 cm^{-1}; **^{1}H-NMR** (400 MHz, $CDCl_3$) δ = 2.80 (s, 3H), 7.23-7.28 (m, 2H), 7.37 (d, *J* = 2.0 Hz, 1H), 7.47-7.58 (m, 3H), 7.75-7.79 (m, 2H), 7.89-7.94 (m, 2H), 8.56 (d, *J* = 2.0 Hz, 1H); **^{13}C{1H}NMR** (125 MHz, $CDCl_3$) δ = 14.9, 114.1, 115.6, 115.7, 115.9, 123.7, 127.3, 127.7, 127.8 (*J* = 12.0 Hz), 129.3, 129.6, 131.8 (*J* = 8.17 Hz), 137.3, 138.8, 140.5, 144.2, 151.9, 162.6, 165.1; **MS** (ESI) m/z 348 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{20}H_{15}FN_3O_2$ $[M+H]^+$ 348.1142 found 348.1141.

7-(4-Chlorophenyl)-2-methyl-3-nitro-5-phenylpyrazolo[1,5-a]pyridine 3n:- Yellow solid, 105 mg, (0.289 mmol), 58%, R_f = 0.42 (EtOAc/Hexane, 10:90); **MP** 142-144 ^oC; **IR** ($CHCl_3$) 768, 1159, 1291, 1379, 1447, 1549, 1634, 2856, 2925, 2961, 3056 cm^{-1}; **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 2.78 (s, 3H), 7.38 (d, *J* = 2.0 Hz, 1H), 7.50-7.57 (m, 5H), 7.75-7.79 (m, 2H), 7.84-7.88 (m, 2H), 8.57 (d, *J* = 2.0 Hz, 1H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 14.9, 114.3, 115.7, 127.3, 128.6, 128.9, 129.3, 129.6, 130.1, 131.0, 136.6, 137.2, 138.8, 140.3, 144.1, 151.9;**MS**

(ESI) m/z 364 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{20}H_{15}ClN_3O_2$ $[M+H]^+$, 364.0847, found 364.0849.

7-(2-Chlorophenyl)-2-methyl-3-nitro-5-phenylpyrazolo[1,5-*a*]pyridine 3o:- Yellow solid, 140 mg, (0.38 mmol), 77%, R_f = 0.30 (EtOAc/Hexane, 10:90); **MP** 198-200 ^oC; **IR** ($CHCl_3$) 760, 1163, 1284, 1326, 1439, 1549, 1633, 2924, 3070 cm^{-1}; **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 2.73 (s, 3H), 7.35 (d, *J* = 1.9 Hz, 1H), 7.45-7.55 (m, 6H), 7.59-7.60 (m, 1H), 7.77-7.79 (m, 2H), 8.61 (d, *J* = 2.1 Hz, 1H); **^{13}C{1H}NMR** (125 MHz, $CDCl_3$) δ = 14.8, 114.7, 116.6, 123.7, 127.0, 127.3, 129.3, 129.6, 130.1, 131.3, 131.4, 131.5, 134.2, 137.2, 138.3, 138.9, 143.6, 151.9; **MS** (ESI) m/z 364 $[M+H]^+$; **HRMS** (ESI, m/z):calcd for $C_{20}H_{15}ClN_3O_2$ $[M+H]^+$ 364.0847, found 364.0871.

2-Methyl-3-nitro-5-phenyl-7-(*p*-tolyl)pyrazolo[1,5-*a*]pyridine 3p:- Yellow solid, 140 mg, (0.408 mmol), 82%, R_f = 0.6 (EtOAc/Hexane, 10:90); **MP** 185-187 ^oC; **IR** ($CHCl_3$) 766, 1291, 1477, 1549, 1634, 2855, 2926, 3043 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 2.47 (s, 3H), 2.78 (s, 3H), 7.36-7.40 (m, 3H), 7.46-7.50 (m, 1H), 7.51-7.56 (m, 2H), 7.73-7.82 (m, 4H), 8.54 (d, *J* = 2.1 Hz, 1H); **^{13}C{1H}NMR** (125, MHz, $CDCl_3$) δ = 14.9, 21.5, 113.7, 115.5, 123.6, 127.3, 128.8, 129.3, 129.4, 129.5, 129.6, 137.5, 138.8, 140.8, 141.7, 144.2, 151.9; **MS** (ESI) m/z 344 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{21}H_{18}N_3O_2$ $[M+H]^+$ 344.1399, found 344.1409.

7-(4-(*tert*-Butyl)phenyl)-2-methyl-3-nitro-5-phenylpyrazolo[1,5-*a*]pyridine 3q:- Yellow solid, 150 mg, (0.389 mmol), 78%, R_f = 0.4 (EtOAc/Hexane, 10:90); **MP** 172-174 ^oC; **IR** ($CHCl_3$) 768, 1291, 1379, 1447, 1509, 1635, 2855, 2926, 3057 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 1.40 (s, 9H), 2.79 (s, 3H), 7.39 (d, *J* = 2.1 Hz, 1H), 7.55-7.45 (m, 3H), 7.61-7.57 (m, 2H), 7.79-7.73 (m, 2H), 7.89-7.84 (m, 2H), 8.53 (d, *J* = 2.1 Hz, 1H); **^{13}C{1H}NMR** (125 MHz, $CDCl_3$) δ = 14.9, 31.2, 34.9, 113.7, 115.6, 123.6, 125.7, 127.3, 128.7, 129.3, 129.4, 129.5, 137.5,

138.8, 141.6, 144.2, 151.5, 153.8; **MS** (ESI) m/z 386 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{24}H_{24}N_3O_2$ $[M+H]^+$ 386.1869, found 386.1874.

7-(4-Fluorophenyl)-5-(4-methoxyphenyl)-2-methyl-3-nitropyrazolo[1,5-*a*]pyridine 3r:- yellow solid, 116 mg, (0.307 mmol), 62%, R_f = 0.5 (EtOAc/Hexane, 10:90); **MP** 206-208 ^oC; **IR** ($CHCl_3$) 753, 827, 1157, 1379, 1473, 1537, 1636, 2851, 2921 cm^{-1}; **^{1}H-NMR** (400 MHz, $CDCl_3$) δ = 2.77 (s, 3H), 3.89 (s, 3H), 7.03-7.08 (m, 2H), 7.23-7.30 (m, 3H), 7.33 (d, *J* = 2.1 Hz, 1H), 7.70-7.76 (m, 2H), 7.87-7.93 (m, 2H), 8.51 (d, *J* = 2.1 Hz, 1H); **^{13}C{1H}NMR** (125 MHz, $CDCl_3$) δ = 14.9,.55.5, 113.0, 114.8, 115.3, 115.9 (*J* = 13.3 Hz), 123.5, 128.5, 129.4, 131.8 (*J* = 8.8 Hz), 138.9, 140.4, 143.8, 151.9, 161.0.; **MS** (ESI) m/z 378 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{21}H_{17}FN_3O_3$ $[M+H]^+$ 378.1248, found 378.1252.

2-Methyl-3-nitro-5-(3-nitrophenyl)-7-(*p*-tolyl)pyrazolo[1,5-*a*]pyridine 3s:- Pale yellow solid, 101 mg, (0.260 mmol), 52%, R_f = 0.5 (EtOAc/Hexane, 5:95); **MP** 182-184 ^oC; **IR** ($CHCl_3$) 1285, 1474, 1532, 1616, 2927, 2960 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 2.48 (s, 3H), 2.80 (s, 3H), 7.38 (d, *J* = 2.0 Hz, 1H), 7.39 (s, 1H), 7.41 (s, 1H), 7.74 (t, *J* = 7.9 Hz, 1H), 7.81 (s, 1H), 7.82 (s, 1H), 8.12 (d, *J* = 8.0 Hz, 1H), 8.35 (dd, J_1 = 2.0 Hz, J_2 = 8.0 Hz, 1H), 8.58 (d, *J* = 2.0 Hz, 1H), 8.60 (d, *J* = 1.8 Hz, 1H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 14.9, 21.6, 114.3, 114.8, 122.2, 124.0, 128.4, 129.5, 129.6, 130.5, 133.2, 138.6, 139.3, 141.2, 141.3, 142.4, 148.9, 152.2; **MS** (ESI) m/z 389 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{21}H_{17}N_4O_4$ $[M+H]^+$ 389.1244, found 389.1249.

2-Ethyl-4-methyl-3-nitro-5-(3-nitrophenyl)-7-(*p*-tolyl)pyrazolo[1,5-*a*]pyridine 3t:- Pale yellow solid, 136 mg, (0.326 mmol), 65%, R_f = 0.5 (EtOAc/Hexane, 5:95); **MP** 178-180 ^oC; **IR** ($CHCl_3$) 981, 1127, 1458, 1526, 1629, 2927, 2960 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 1.36 (t, *J* = 7.5 Hz, 3H), 2.45 (s, 3H), 2.52 (s, 3H), 3.11 (q, *J* = 7.5 Hz, 2H), 7.02 (s, 1H), 7.34 (d, *J* =

8.0 Hz, 2H), 7.70 (t, *J* = 8.0 Hz, 1H), 7.75-7.78 (m, 3H), 8.29-8.33 (m, 2H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 12.6, 18.3, 21.5, 21.8, 117.2, 123.3, 124.1, 129.3, 129.6, 129.8, 135.4, 135.5, 139.3, 140.6, 141.0, 148.4, 156.2; **MS** (ESI) m/z 417 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{23}H_{21}N_4O_4$ $[M+H]^+$ 417.1518, found 417.1518.

7-(4-*tert*-Butylphenyl)-2-methyl-3-nitro-5-(3-nitrophenyl)pyrazolo[1,5-*a*]pyridine 3u:- yellow solid, 150 mg, (0.348 mmol), 70%, R_f = 0.5 (EtOAc/Hexane, 10:90); **MP** 168-170 ^oC; **IR** ($CHCl_3$) 757, 809, 1026, 1158, 1296, 1346, 1475, 1535, 1635, 2867, 2928 cm^{-1}; **^{1}H-NMR** (400 MHz, $CDCl_3$) δ = 1.41 (s, 9H), 2.82 (s, 3H), 7.40-7.41 (m, 1H), 7.60-7.63 (m, 2H), 7.75 (t, *J* = 8.0 Hz, 1H), 7.87-7.90 (m, 2H), 8.10-8.14 (m, 1H), 8.32-8.37 (m, 1H), 8.59-8.61 (m, 2H); **^{113}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 14.9, 31.2, 34.7, 114.2, 115.0, 122.1, 124.0, 125.8, 128.3, 129.4, 130.4, 133.2, 138.6, 139.3, 141.3, 142.3, 148.9, 152.1, 154.2; **MS** (ESI) m/z 431 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{24}H_{23}N_4O_4$ $[M+H]^+$ 431.1713, found 431.1720.

2-Methyl-3-nitro-7-phenyl-5-(trifluoromethyl)pyrazolo[1,5-*a*]pyridine 3v:- Yellow solid, 68 mg, (0.212 mmol), 42%, R_f = 0.4 (EtOAc/Hexane, 10:90); **MP** 144-146 ^oC; **IR** ($CHCl_3$) 694, 767, 887, 1036, 1078, 1171, 1270, 1306, 1378, 1402, 1549, 1646, 2852, 2923 cm^{-1}; **^{1}H-NMR** (400 MHz, $CDCl_3$) δ = 2.80 (s, 3H), 7.29-7.31 (m, 1H), 7.57-7.60 (m, 3H), 7.87-7.90 (m, 2H), 8.65 (s, 1H); **^{13}C{1H}NMR** (125 MHz, $CDCl_3$) δ = 14.9, 111.7, 114.5 (*J* = 4.5 Hz), 121.6, 123.8, 125.0, 128.8, 129.7, 130.6, 131.1, 132.3 (*J* = 34 Hz), 137.3, 142.7, 152.3; **MS** (ESI) m/z 322 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{15}H_{11}F_3N_3O_2$ $[M+H]^+$ 322.0797, found 322.0787.

5-*tert*-Butyl-2-methyl-3-nitro-7-phenylpyrazolo[1,5-*a*]pyridine 3w:- Wine red solid, 115 mg, (0.372 mmol), 74%, R_f = 0.6 (EtOAc/Hexane, 5:95); **MP** 134-136 ^oC; **IR** ($CHCl_3$) 742, 928, 1214, 1382, 1413, 1638, 3019 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 1.45 (s, 9H), 2.75 (s, 3H), 7.17 (d, *J* = 2.2 Hz, 1H), 7.54-7.59 (m, 3H), 7.82-7.86 (m, 2H), 8.30 (d, *J* = 2.2 Hz, 1H);

^{13}C{1H}NMR (100 MHz, $CDCl_3$) δ = 14.9, 30.7, 35.7, 112.6, 115.5, 123.2, 128.6, 129.7, 130.3, 132.1, 138.5, 140.9, 151.7, 155.9; **MS** (ESI) m/z 310 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{18}H_{20}N_3O_2$ $[M+H]^+$ 310.1550, found 310.1543; $C_{18}H_{19}N_3O_2Na$ $[M+Na]^+$ 332.1369, found 332.1364.

5-*tert*-Butyl-2-ethyl-4-methyl-3-nitro-7-phenylpyrazolo[1,5-*a*]pyridine 3x:- Yellow solid, 108 mg, (0.320 mmol) 64%, R_f = 0.6 (EtOAc /Hexane, 5:95); **MP** 138-140 ^oC; **IR** ($CHCl_3$) 742, 928, 1214, 1382, 1472, 1542, 1638, 3019 cm^{-1}; **^{1}H-NMR** (400 MHz, $CDCl_3$) δ = 1.32 (t, *J* = 7.6 Hz, 3H), 1.54 (s, 9H), 2.69 (s, 3H), 3.03 (q, *J* = 7.6 Hz, 2H), 7.20 (s, 1H), 7.51-7.55 (m, 3H), 7.80-7.84 (m, 2H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 12.7, 19.4, 21.7, 31.1, 36.4, 115.9, 125.1, 125.2, 128.5, 129.7, 129.8, 132.6, 137.8, 138.1, 151.1, 156.2; **MS** (ESI) m/z 338 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{20}H_{24}N_3O_2$ $[M+H]^+$ 338.1863, found 338.1859.

5-(*tert*-Butyl)-7-(4-(*tert*-butyl)phenyl)-2-methyl-3-nitropyrazolo[1,5-*a*]pyridine 3y:- Yellow solid, 136 mg, (0.372 mmol), 75%, R_f = 0.4 (EtOAc/Hexane, 10:90); **MP** 152-154 ^{o} C; **IR** ($CHCl_3$) 768, 1159, 1379, 1447, 1549, 1634, 2856, 2925, 3056 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 1.39 (s, 9H), 1.44 (s, 9H), 2.76 (s, 3H), 7.15-7.21 (m, 1H), 7.53-7.62 (m, 2H), 7.77-7.84 (m, 2H), 8.25-8.31 (m, 1H); **^{13}C{1H}NMR** (125 MHz, $CDCl_3$) δ = 14.9, 30.6, 31.2, 34.9, 35.6, 112.3, 115.3, 123.0, 125.6, 129.3, 132.8, 138.5, 140.8, 151.6, 153.5, 155.9; **MS** (ESI) m/z 366 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{22}H_{28}N_3O_2$ $[M+H]^+$ 366.2182, found 366.2200.

7-Ethyl-2,5-dimethyl-3-nitropyrazolo[1,5-*a*]pyridine 3z:- Yellow solid, 58 mg, (0.264 mmol), 53%, R_f = 0.6 (EtOAc/Hexane, 20:80); **MP** 142-144 ^oC; **IR** ($CHCl_3$) 769, 1055, 1294, 1458, 1551, 2853, 2924 cm^{-1}; **^{1}H-NMR** (400 MHz, $CDCl_3$) δ = 1.44 (t, *J* = 7.5 Hz, 3H), 2.51 (s, 3H), 2.77 (s, 3H), 3.17 (q, *J* = 7.5 Hz, 2H), 6.77 (s, 1H), 8.01 (s, 1H); **^{13}C{1H}NMR** (75 MHz,

$CDCl_3$) δ = 11.2, 14.7, 21.8, 23.7, 115.0, 115.5, 138.0, 143.0, 143.9, 151.2; **MS** (ESI) m/z 220 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{11}H_{14}N_3O_2$ $[M+H]^+$ 220.1080, found 220.1080.

2-Methyl-3-nitro-7-phenyl-5-(pyridin-3-yl)pyrazolo[1,5-*a*]pyridine 3aa:- Pale yellow solid,105 mg, (0.318 mmol), 63%, R_f = 0.4 (EtOAc/Hexane, 5:95); **MP** 154-156 ^oC; **IR** ($CHCl_3$) 770, 1125, 1413, 1508, 1636, 2824, 3065, 3125 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 2.77 (s, 3H), 7.37 (d, *J* = 2.0 Hz, 1H), 7.46-7.56 (m, 1H), 7.57-7.60 (m, 3H), 7.89-7.91 (m, 2H), 8.08-8.10 (m, 1H), 8.57 (d, *J* = 2.0 Hz, 1H), 8.75 (s, 1H), 9.03 (s, 1H); **^{13}C{1H}NMR** (75 MHz, $CDCl_3$) δ = 14.9, 115.0, 117.0, 123.7, 124.8, 125.8, 127.4, 129.3, 129.6, 136.5, 137.3, 139.0, 139.4, 144.2, 149.3, 150.1, 151.8; MS (ESI) m/z 331 $[M+H]^+$; HRMS (ESI, m/z): calcd for $C_{19}H_{15}N_4O_2$ $[M+H]^+$ 331.1189, found 331.1208.

2-Methyl-3-nitro-5-phenyl-7-(pyridin-2-yl)pyrazolo[1,5-*a*]pyridine 3ab:- Pale yellow solid, 98 mg, (0.296 mmol), 60%, R_f = 0.4 (EtOAc/Hexane, 5:95); **MP** 152-155 ^oC; **IR** ($CHCl_3$) 773, 1124, 1414, 1509, 1600, 2825, 3066, 3126 cm^{-1}; **^{1}H-NMR** (300 MHz, $CDCl_3$) δ = 2.83 (s, 3H), 7.45-7.57 (m, 4H), 7.84 (d, *J* = 6.8 Hz, 2H), 7.91-7.97 (m, 1H), 8.10 (d, *J* = 2.2 Hz, 1H), 8.63-8.65 (m, 2H), 8.83 (d, *J* = 3.3 Hz, 1H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 14.9, 114.9, 116.9, 124.7, 125.8, 127.4, 129.2, 129.5, 136.5, 137.3, 138.9, 139.4, 144.3, 149.2, 150.0, 151.7; MS (ESI) m/z 331 $[M+H]^+$; HRMS (ESI, m/z): calcd for $C_{19}H_{15}N_4O_2$ $[M+H]^+$ 331.1189, found 331.1208.

2-Methyl-3-nitro-7-phenyl-5-(thiophen-2-yl)pyrazolo[1,5-*a*]pyridine 3ac:- Yellow solid, 120 mg, (0.36 mmol), 72%, R_f = 0.30 (EtOAc/Hexane, 10:90); **MP** 192-194 ^oC; **IR** ($CHCl_3$) 761, 1006, 1283, 1332, 1459, 1543, 1629, 2923, 3092 cm^{-1}; **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 2.76 (s, 3H), 7.18-7.19 (m, 1H), 7.34 (d, *J* = 1.9 Hz, 1H), 7.49 (dd, J_1 = 1.0 Hz, J_2 = 5.0 Hz, 1H), 7.75-7.59 (m, 3H), 7.62 (dd, J_1 = 1.0 Hz, J_2 = 5.0 Hz, 1H), 7.86-7.88 (m, 2H), 8.53 (d, *J* = 1.9 Hz,

1H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 14.8, 111.8, 114.3, 126.4, 128.2, 128.6, 128.7, 129.7, 130.5, 131.5, 137.3, 138.7, 140.4, 141.7, 151.9; **MS** (ESI) m/z 336 $[M+H]^+$; **HRMS** (ESI, m/z):calcd for $C_{18}H_{14}SN_3O_2$ $[M+H]^+$ 336.0801, found 336.0821.

2-*iso*-Butyl-3-nitro-5,7-diphenylpyrazolo[1,5-*a*]pyridine 3ad:- Pale yellow solid, 154 mg, (0.415 mmol), 83%, R_f = 0.6 (EtOAc/hexane, 5:95); **MP** 126-128 ^oC; **IR** ($CHCl_3$) 761, 1285, 1439, 1552, 1634, 2921, 3019 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 1.02 (d, *J* = 6.7 Hz, 6H), 2.26 (sep, *J* = 6.8 Hz, 1H), 3.08 (d, *J* = 7.1 Hz, 2H), 7.41 (d, *J* = 2.1 Hz, 1H), 7.47-7.50 (m, 1H), 7.52-7.55 (m, 2H), 7.55-7.59 (m, 3H), 7.76-7.79 (m, 2H), 7.90-7.92 (m, 2H), 8.58 (d, *J* = 2.0 Hz, 1H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 22.6, 27.7, 36.8, 114.2, 115.8, 123.5, 127.3, 128.6, 129.3, 129.5, 129.7, 130.4, 137.5, 138.9, 144.1, 144.2, 154.7; **MS** (ESI) m/z 372 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{23}H_{22}N_3O_2$ $[M+H]^+$ 372.1706, found 372.1709.

2-*iso*-Butyl-5-(naphthalen-1-yl)-3-nitro-7-phenylpyrazolo[1,5-a]pyridine 3ae:- Yellow solid, 133 mg, (0.315 mmol), 63%, R_f = 0.5 (EtOAc/Hexane, 10:90); **MP** 142-144 ^oC; **IR** ($CHCl_3$) 750, 1214, 1449, 1625, 1662, 2853, 2924, 2955, 3019 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 1.03 (d, *J* = 6.7 Hz, 6H), 2.27 (sep, *J* = 6.8 Hz, 1H), 3.09 (d, *J* = 7.1 Hz, 2H), 7.54 (d, *J* = 2.1 Hz, 1H), 7.54-7.61 (m, 5H), 7.86-7.90 (m, 1H), 7.90-7.92 (m, 1H), 7.93-7.98 (m, 3H), 8.00 (d, *J* = 8.6 Hz, 1H), 8.25 (s, 1H), 8.70 (d, *J* = 2.1 Hz, 1H); **^{13}C{1H}NMR** (125 MHz, $CDCl_3$) δ = 22.6, 27.7, 36.8, 114.4, 115.9, 124.5, 126.9, 127.0, 127.2, 127.8, 128.6, 129.2, 129.8, 130.4, 131.8, 133.5, 133.6, 134.7, 139.0, 141.6, 143.9, 154.7; **MS** (ESI) m/z 422 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{27}H_{24}N_3O_2$ $[M+H]^+$ 422.1869, found 422.1867.

2-*iso*-Butyl-5-(4-methoxyphenyl)-3-nitro-7-phenylpyrazolo[1,5-*a*]pyridine 3af:- Yellow solid, 120 mg, (0.299 mmol), 60%, R_f = 0.5 (EtOAc/Hexane, 10:90); **MP** 150-152 ^oC; **IR** ($CHCl_3$) 695, 762, 829, 1156, 1260, 1298, 1377, 1470, 1544, 1633, 2927 cm^{-1}; **^{1}H-NMR** (500

MHz, $CDCl_3$) δ = 1.02 (d, *J* = 6.7 Hz, 6H), 2.25 (sep, *J* = 6.8 Hz, 1H), 3.07 (d, *J* = 7.1 Hz, 2H), 3.89 (s, 3H), 7.02-7.11 (m, 2H), 7.37 (d, *J* = 2.0 Hz, 1H), 7.54-7.58 (m, 3H), 7.72-7.76 (m, 2H), 7.88-7.93 (m, 2H), 8.53 (d, *J* = 2.0 Hz, 1H); **^{13}C{1H}NMR** (125 MHz, $CDCl_3$) δ = 22.7, 27.6, 36.9, 55.5, 113.2, 114.7, 115.4, 128.5, 129.7, 130.3, 131.9, 139.1, 141.4, 143.7, 154.6, 160.9; **MS** (ESI) m/z 402 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{24}H_{24}N_3O_3$ $[M+H]^+$ 402.1812, found 402.1813.

5-(4-Bromophenyl)-2-*iso*-butyl-3-nitro-7-phenylpyrazolo[1,5-*a*]pyridine 3ag:- Yellow solid, 162 mg, (0.360 mmol), 72%, R_f = 0.4 (EtOAc/Hexane, 10:90); **MP** 147-149 ^oC; **IR** ($CHCl_3$) 767, 1159, 1291, 1379, 1447, 1635, 2863, 2926, 3055 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 1.02 (d, *J* = 6.7 Hz, 6H), 2.26 (sep, *J* = 6.8 Hz, 1H), 3.08 (d, *J* = 7.1 Hz, 2H), 7.33-7.36 (m, 1H), 7.54-7.59 (m, 3H), 7.66 (q, *J* = 8.5 Hz, 4H), 7.89-7.91 (m, 2H), 8.55 (s, 1H); **^{13}C{1H}NMR** (125 MHz, $CDCl_3$) δ = 22.6, 27.7, 36.7, 114.1, 115.3, 123.5, 124.1, 128.6, 128.8, 129.7, 130.5, 131.7, 132.5, 136.4, 138.9, 141.7, 142.7, 154.7; **MS** (ESI) m/z 450 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{23}H_{21}BrN_3O_2$ $[M+H]^+$ 450.0817, found 450.0818.

7-(4-Fluorophenyl)-2-*iso*-butyl-3-nitro-5-phenylpyrazolo[1,5-*a*]pyridine 3ah:- Yellow solid, 100 mg, (0.257 mmol), 51%, R_f = 0.5 (EtOAc/Hexane, 10:90); **MP** 158-160 ^oC; **IR** ($CHCl_3$) 768, 838, 1158, 1293, 1376, 1474, 1548, 1635, 2869, 2928 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 1.02 (d, *J* = 6.7 Hz, 6H), 2.25 (sep, *J* = 6.8 Hz, 1H), 3.07 (d, *J* = 7.1 Hz, 2H), 7.23-7.28 (m, 2H), 7.23-7.28 (m, 2H), 7.38 (d, *J* = 2.0 Hz, 1H), 7.47-7.51 (m, 1H), 7.52-7.56 (m, 2H), 7.75-7.78 (m, 2H), 7.89-7.94 (m, 2H), 8.58 (d, *J* = 2.0 Hz, 1H); **^{13}C{1H}NMR** (125 MHz, $CDCl_3$) δ = 22.6, 27.6, 36.7, 114.3, 115.6, 115.9, 129.4 (*J* = 32 Hz), 131.8 (*J* = 8.17 Hz), 137.4, 138.9, 140.5, 144.1, 154.6, 162.8, 164.8; **MS** (ESI) m/z 390 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{23}H_{21}FN_3O_2$ $[M+H]^+$ 390.1612, found 390.1616.

2-Ethyl-3-nitro-5,7-diphenylpyrazolo[1,5-*a*]pyridine 3ai:- Yellow solid, 59 mg, (0.172 mmol), 34%, R_f = 0.6 (EtOAc /Hexane, 20:80); **MP** 158-159 ^oC; **IR** ($CHCl_3$) 756, 1287, 1442, 1547, 1633, 2925, 2979, 3057 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 1.38 (t, *J* = 7.4 Hz, 3H), 3.21 (q, *J* = 7.5 Hz, 2H), 7.40 (d, *J* = 2.0 Hz, 1H), 7.47-7.58 (m, 6H), 7.76-7.78 (m, 2H), 7.91-7.93 (m, 2H), 8.58 (d, *J* = 2.0 Hz, 1H); **^{13}C{1H}NMR** (75 MHz, $CDCl_3$) δ = 12.2, 22.0, 114.1, 115.8, 127.3, 128.6, 129.3, 129.5, 129.8, 130.4, 131.8, 137.5, 139.0, 141.7, 144.2, 156.7; **MS** (ESI) m/z 344 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{21}H_{18}N_3O_2$ $[M+H]^+$ 344.1393, found 344.1419; $C_{21}H_{17}N_3O_2Na$ $[M+Na]^+$ 366.1213, found 366.1238.

3-Nitro-5,7-diphenyl-2-(trifluoromethyl)pyrazolo[1,5-*a*]pyridine 3aj:- Yellow solid, 128 mg, (0.334 mmol), 67%, R_f = 0.6 (EtOAc/Hexane, 30:70); **MP** 256-258 ^oC; **IR** ($CHCl_3$) 761, 1293, 1452, 1580, 1637, 3049 cm^{-1}; **^{1}H-NMR** (400 MHz, $CDCl_3$) δ = 7.53-7.60 (m, 7H), 7.77-7.80 (m, 2H), 7.88-7.91 (m, 2H), 8.63 (d, *J* = 2.0 Hz, 1H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 114.3, 117.3, 118.3, 121.9, 127.4, 128.8, 129.5, 129.8, 136.8, 139.2, 140.2, 140.5, 142.4, 145.6; **MS** (ESI) m/z 384 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{20}H_{13}F_3N_3O_2$ $[M+H]^+$ 384.0954, found 384.0970.

2-Methyl-3-nitro-7-phenylpyrazolo[1,5-*a*]pyridine 3ak:- Light brown colour solid, 80 mg, (0.316 mmol), 63%, R_f = 0.6 (EtOAc / Hexane, 20:80); **MP** 165-167 ^oC; **IR** ($CHCl_3$) 756, 1294, 1480, 1535, 1630, 2854, 2924 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 2.77 (s 3H), 7.15 (dd, J_1 = 1.3 Hz, J_2 = 7.3 Hz, 1H), 7.55-7.57 (m, 3H), 7.68-7.72 (m, 1H), 7.84-7.86 (m, 2H), 8.37 (dd, J_1 = 1.4 Hz, J_2 = 8.8 Hz, 1H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 14.8, 116.3, 117.2, 128.6, 129.6, 130.4, 130.9, 131.7, 138.6, 141.7, 151.4; **MS** (ESI) m/z 254 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{14}H_{12}N_3O_2$ $[M+H]^+$ 254.0924, found 254.0931.

2-Ethyl-4-methyl-3-nitro-7-phenylpyrazolo[1,5-*a*]pyridine 3al:- Yellow solid, 78 mg, (0.277 mmol), 55%, R_f = 0.6 (EtOAc /Hexane, 10:90); **MP** 147-150 ^oC; **IR** ($CHCl_3$) 763, 1277, 1483, 1532, 1617, 2932, 2975 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 1.33 (t, *J* = 7.5 Hz, 3H), 2.75 (s, 3H), 3.10 (q, *J* = 7.5 Hz, 2H), 7.00 (d, *J* = 7.3 Hz, 1H), 7.36 (dd, J_1 = 0.9 Hz, J_2 = 7.5 Hz, 1H), 7.50-7.53 (m, 3H), 7.80-7.82 (m, 2H); **^{13}C{1H}NMR** (125 MHz, $CDCl_3$) δ = 12.4, 21.3, 21.9, 115.8, 127.7, 128.4, 129.7, 129.9, 131.6, 132.3, 137.3, 139.4, 155.7; **MS** (ESI) m/z 282 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{16}H_{16}N_3O_2$ $[M+H]^+$ 282.1237, found 282.1257.

2-Ethyl-3-nitro-7-phenylpyrazolo[1,5-*a*]pyridine 3am:- Yellow colour solid, 56 mg, (0.209 mmol), 42%, R_f = 0.6 (EtOAc /Hexane, 20:80); **MP** 138-140 ^oC; **IR** ($CHCl_3$) 758, 1360, 1454, 1558, 2870, 3061 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 1.36 (t, *J* = 6.8 Hz, 3H), 3.20 (q, *J* = 7.3 Hz, 2H), 7.16 (d, *J* = 7.2 Hz, 1H), 7.26 (s, 1H), 7.54-7.56 (m, 2H), 7.69 (t, *J* = 8.8 Hz, 1H), 7.87-7.89 (m, 2H), 8.38 (dd, J_1 = 1.4 Hz, J_2 = 8.8 Hz, 1H); **^{13}C{1H}NMR** (125 MHz, $CDCl_3$) δ = 12.1, 21.9, 116.2, 117.3, 128.5, 129.7, 130.3, 130.9, 131.7, 138.8, 141.7, 156.1; **MS** (ESI) m/z 268 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{15}H_{14}N_3O_2$ $[M+H]^+$ 268.1086, found 268.1099.

2,4-Dimethyl-3-nitro-7-phenylpyrazolo[1,5-*a*]pyridine 3am':- Yellow colour solid, 20 mg, (0.074 mmol), 15%, R_f = 0.6 (EtOAc /Hexane, 20:80); **MP** 138-140 ^oC; **IR** ($CHCl_3$) 758, 1360, 1440, 1530, 1616, 2871, 3060 cm^{-1}; **^{1}H-NMR** (400 MHz, $CDCl_3$) δ = 2.68 (s, 3H), 2.77 (s, 3H), 6.99 (d, *J* = 7.5 Hz, 1H), 7.37 (dd, J_1 = 0.9 Hz, J_2 = 7.5 Hz, 1H), 7.51-7.53 (m, 3H), 7.77-7.79 (m, 2H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 14.9, 21.3, 115.8, 127.6, 128.5, 129.6, 129.9, 131.6, 132.2, 137.2, 139.3, 151.1; **MS** (ESI) m/z 268 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{15}H_{14}N_3O_2$ $[M+H]^+$ 268.1086, found 268.1099.

Gram scale procedure for the synthesis of 2-Methyl-3-nitro-5,7-diphenylpyrazolo[1,5-*a*]pyridine (10 mmol scale) 3a:- 3,5-Dimethyl-4-nitro-1*H*-pyrazole (10 mmol, 1.41 g), K_2CO_3 (33 mmol, 4.5 g), 1,3-diphenylprop-2-yn-1-one **2a** (10 mmol, 2.06 g) were taken into a 100 mL round bottom flask and added DMSO (25 mL). The reaction flask was placed in an oil bath, heated to 120 ^oC and stirred at the same temperature for 4 h. The reaction mixture was cooled to room temperature, diluted with water, extracted with ethyl acetate (2 x 200 mL), washed with brine, dried over anhydrous Na_2SO_4 and filtered. The solvent was removed in *vacuo* to afford a crude residue. The residue was purified by flash column chromatography (hexane/EtOAc, 95:5) on silica gel to afford 2-methyl-3-nitro-5,7-diphenylpyrazolo[1,5-*a*]pyridine **3a** (2.56 g, 7.8 mmol, 78% yield).

Procedure for the reaction of 1f and 1a:- Ethyl 3,5-dimethyl-1*H*-pyrazole-4-carboxylate **1f** (0.5 mmol, 84 mg), K_2CO_3 (1.65 mmol, 227 mg), 1,3-diphenylprop-2-yn-1-one **2a** (0.5 mmol, 103 mg) were taken into a 10 mL screw cap vial and added DMSO (2 mL). The vial was placed in a metal heating block, heated to 120 ^oC and stirred at the same temperature for 4 h. The reaction mixture was cooled to room temperature, diluted with water, extracted with ethyl acetate (2 x 20 mL), washed with brine, dried over anhydrous Na_2SO_4 and filtered. The solvent was removed in *vacuo* to afford a crude residue. The residue was purified by flash column chromatography (hexane/EtOAc, 95:5) on silica gel to afford the corresponding aza-Michael adduct **4** and pyrazolopyridine **5**.

Ethyl 3,5-dimethyl-1-(3-oxo-1,3-diphenylprop-1-en-1-yl)-1*H*-pyrazole-4-carboxylate 4:- Yellow liquid, 11 mg 6%, R_f = 0.5 (EtOAc/Hexane,10:90); **IR** ($CHCl_3$) 770, 1091, 1271, 1428, 1554, 168, 1704, 2853, 2923 cm^{-1} ; **^{1}H NMR** (400 MHz, $CDCl_3$) δ 1.34 (t, *J* = 8.0 Hz, 3H), 2.30 (s, 3H), 2.34 (s, 3H), 4.26 (q, *J* = 8.0 Hz, 2H), 7.31-7.34 (m, 3H), 7.37-7.54 (m, 6H), 7.83-7.87

(m, 2H); **^{13}C{1H}NMR** (126 MHz, $CDCl_3$) δ = 12.2, 14.3, 14.4, 59.7, 110.8, 121.7, 126.9, 128.3, 129.1, 131.3, 133.0, 135.1, 137.4, 145.9, 146.8, 152.2, 164.2, 190.0; **MS** (ESI) m/z 375 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{23}H_{22}N_2O_3$ $[M+H]^+$ 375.1703 found 375.1718.

Ethyl 2-methyl-5,7-diphenylpyrazolo[1,5-*a*]pyridine-3-carboxylate 5[11]:- off-white solid, 12 mg 7 %, **R_f** = 0.5 (EtOAc/Hexane,05:95); **IR** ($CHCl_3$) 761, 1091, 1220, 1492, 1542, 1633, 1692, 2852, 2921 cm^{-1}; **^{1}H NMR** (500 MHz, $CDCl_3$) δ 1.45 (t, *J* = 7.0 Hz, 3H), 2.71 (s, 3H), 4.42 (q, *J* = 7.1 Hz, 2H), 7.18-7.19 (d, 1H), 7.39-7.44 (m, 1H), 7.46-7.55 (m, 5H), 7.70-7.74 (m, 2H); 7.90-7.94 (m, 2H); 8.35-8.36 (d, 1H); **^{13}C{1H}NMR** (101 MHz, $CDCl_3$) δ = 14.6, 14.9, 59.7, 101.7, 113.7, 114.6, 127.1, 128.5, 128.7, 129.1, 129.5, 129.8, 133.0, 138.4, 140.2, 140.6, 143.6, 155.7, 164.4; **MS** (ESI) m/z 357 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{23}H_{21}N_2O_2$ $[M+H]^+$ 357.1598, found 357.1619.

Synthesis of aza-Michael adduct 6:- 3,4,5-Trimethyl-1*H*-pyrazole **1g** (0.5 mmol, 55 mg), K_2CO_3 (1.65 mmol, 227 mg), 1,3-diphenylprop-2-yn-1-one **2a** (0.5 mmol, 103 mg) were taken into a 10 mL screw cap vial and added DMSO (2 mL). The vial was placed in a metal heating block, heated to 120 ^oC and stirred at the same temperature for 4 h. The reaction mixture was cooled to room temperature, diluted with water, extracted with ethyl acetate (2 x 20 mL), washed with brine, dried over anhydrous Na_2SO_4 and filtered. The solvent was removed in *vacuo* to afford a crude residue. The residue was purified by flash column chromatography (hexane/EtOAc, 95:5) on silica gel to afford the corresponding aza-Michael adduct **4**. The geometry of this compound was found to be (*Z*) by nOe (see supporting information).

(*Z*)-1,3-Diphenyl-3-(3,4,5-trimethyl-1*H*-pyrazol-1-yl)prop-2-en-1-one 6:- Yellow solid, 34 mg, (0.107 mmol), 21 %, R_f = 0.30 (EtOAc/Hexane, 10:90); **MP** 187-189 ^oC; **IR** ($CHCl_3$) 775, 1163, 1281, 1575, 1632, 2918, 3060 cm^{-1}; **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 1.71 (s, 3H), 1.86 (s,

3H), 1.97 (s, 3H), 6.88 (s, 1H), 7.30 (t, *J* = 7.9 Hz, 2H), 7.35-7.44 (m, 6H), 7.70-7.77 (m, 2H); **^{13}C{1H}NMR** (100 MHz, $CDCl_3$) δ = 7.9, 10.5, 16.7, 113.9, 120.0, 127.5, 128.1, 128.8, 130.6, 131.9, 136.2, 137.9, 138.1, 147.5, 149.7, 192.1; **MS** (ESI) m/z 317 $[M+H]^+$; **HRMS** (ESI, m/z):calcd for $C_{21}H_{21}N_2O$ $[M+H]^+$ 317.1648, found 317.1664.

Procedure for the reduction of nitro group (1 mmol scale) 7:- 2-Methyl-3-nitro-5,7-diphenylpyrazolo[1,5-*a*]pyridine **3a** (329 mg, 1.0 mmol) was suspended in water (10 mL) and added a 3.5 M KOH (10 mL) solution. To this mixture, solid $SnCl_2{\cdot}2H_2O$ (0.9 g, 4 mmol) was added portion-wise. The reaction mixture was stirred at 100 ^oC and monitored by TLC. After 0.5 h the reaction mixture was cooled to room temperature and insoluble material was filtered. The filtrate was extracted with chloroform (2 x 20 mL) and the organic phase was washed with brine (5 mL). The organic phase was dried over anhydrous Na_2SO_4, filtered and concentrated to afford 2-methylpyrazolo[1,5-*a*]quinolin-3-amine **5**.

Procedure for the reduction of nitro group (10 mmol scale) 7:- 2-Methyl-3-nitro-5,7-diphenylpyrazolo[1,5-*a*]pyridine **3a** (3.29 g, 10 mmol) was suspended in water (100 mL) and added a 3.5 M KOH (100 mL) solution. To this mixture, solid $SnCl_2{\cdot}2H_2O$ (9.0 g, 40 mmol) was added portion wise. The reaction mixture was stirred at 100 ^oC, in an oil bath, for 0.5 h. The reaction mixture was cooled to room temperature and insoluble material was filtered. The filtrate was extracted with chloroform (2 x 200 mL) and the organic phase was washed with brine (25 mL). The organic phase was dried over anhydrous Na_2SO_4, filtered and concentrated to obtain **5** without further purification (1.70 g, 5.70 mmol, 57% yield).

2-Methyl-5,7-diphenylpyrazolo[1,5-*a*]pyridin-3-amine 7:- Pale yellow powder, 215 mg, (0.719 mmol), 72%, R_f = 0.3 (EtOAc/Hexane, 10:90); **MP** 178-180 ^oC; **IR** ($CHCl_3$) 755, 1155, 1635, 2922, 3446 cm^{-1}; **^{1}H-NMR** (500 MHz, $CDCl_3$) δ = 2.78 (s, 3H), 7.40 (d, *J* = 2.0 Hz, 1H),

7.48-7.51 (m, 1H), 7.53-7.55 (m, 2H), 7.55-7.60 (m, 3H), 7.77-7.79 (m, 2H), 7.89-7.91 (m, 2H), 8.57 (d, J = 2.0 Hz, 1H); **^{13}C{1H}NMR** (125 MHz, $CDCl_3$) δ = 14.9, 113.9, 115.8, 127.3, 128.7, 129.3, 129.6, 129.7, 130.5, 131.8, 137.4, 138.8, 141.6, 144.2, 151.9; **MS** (ESI) m/z 300 $[M+H]^+$; **HRMS** (ESI, m/z): calcd for $C_{20}H_{18}N_3[M+H]^+$ 300.1495, found 300.1490.

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Notes

The authors declare no competing financial interest.

ASSOCIATED CONTENT

Supporting Information

The Supporting Information is available free of charge on the ACS Publications website at DOI: 10.1021/acs.joc.

Optimization data, and spectra (PDF)

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