

Ethyl 5-amino-3-(4,6-dimethylpyrimidin-2-ylamino)-1-methyl-1H-pyrazole-4-carboxylate and ethyl 5-amino-3-(4,6-dimethylpyrimidin-2-ylamino)-1-(2-nitrophenylsulfonyl)-1H-pyrazole-4-carboxylate

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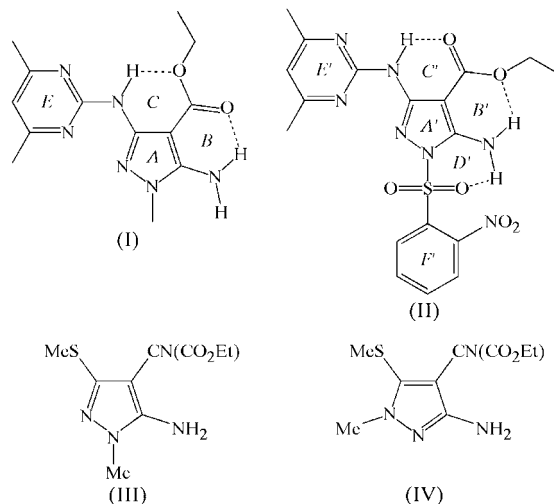
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The molecular structures of ethyl 5-amino-3-(4,6-dimethylpyrimidin-2-ylamino)-1-methyl-1H-pyrazole-4-carboxylate, C₁₃H₁₈N₆O₂, (I), and ethyl 5-amino-3-(4,6-dimethylpyrimidin-2-ylamino)-1-(2-nitrophenylsulfonyl)-1H-pyrazole-4-carboxylate, C₁₈H₁₉N₇O₆S, (II), have been determined. There are two intramolecular N—H···O bonds and one intermolecular N—H···O hydrogen bond in (I). The rings formed by the N—H···O hydrogen bonds are almost planar. In (II), three intramolecular N—H···O hydrogen bonds exist.

Comment

Many pyrazoles and pyrimidines show fungicidal or herbicidal activities (Malhotra *et al.*, 1997; Takao *et al.*, 1994; Ohvchi & Okada, 1998; Kleschick *et al.*, 1992). Some of these compounds, for example, flumetsulam, metosulam and pyrazosulfuron, have been sold commercially as agrochemicals. Pyrazole and pyrimidine derivatives have also been investigated extensively with regard to pharmacological applications (Kees *et al.*, 1996; Lesyk *et al.*, 1998). In order to discover further biologically active pyrazole and pyrimidine compounds, a series of novel pyrimidinylaminopyrazole derivatives were designed and synthesized. Some showed high fungicidal or herbicidal activity. It has been reported that the position of the acid H atom on a pyrazole ring is not stationary. For example, for 3{5}-substituted pyrazoles, the position of the acid H atom could be correlated with the Hammett σ_m parameter of the 3{5}-substituent. Substituents with positive σ_m values prefer the 3-position, while those with negative σ_m

adopt the 5-position (Lopez *et al.*, 1993; Malcolm *et al.*, 1996). It is possible that the substitution reaction occurs at the two endocyclic N atoms simultaneously, and thus a pair of isomers



could be obtained. For instance, when the 4-position substituents are cyano and ethoxycarbonyl groups, respectively, the ratios of isomer (III) to isomer (IV) are 100:83 and 100:1.13 (Ren *et al.*, 2004). When ethyl 5-amino-3-(4,6-dimethylpyrimidin-2-ylamino)-1H-pyrazole-4-carboxylate was reacted with either iodidemethane or 2-nitrobenzenesulfonyl chloride, only one primary product was obtained in each case, found by X-ray determination to be (I) and (II), respectively (Figs. 1 and 2, and Tables 1 and 3). According to Fig. 2, the nitro group in the *ortho*-position is twisted by 48.07 (13)^o from the plane of the benzene ring. This tilting of the nitro group avoids unfavourable steric contacts with atom O1 (Jeyakanthan *et al.*, 1999). Similarly, the interplanar angle between the benzene ring, F', and the pyrazole ring, A', is 77.08 (9)^o. The molecular structure of (II) is stabilized by three intramolecular N—H···O hydrogen bonds (Table 4). Rings A', B', C' and D' are not coplanar; the dihedral angles between the planes of rings

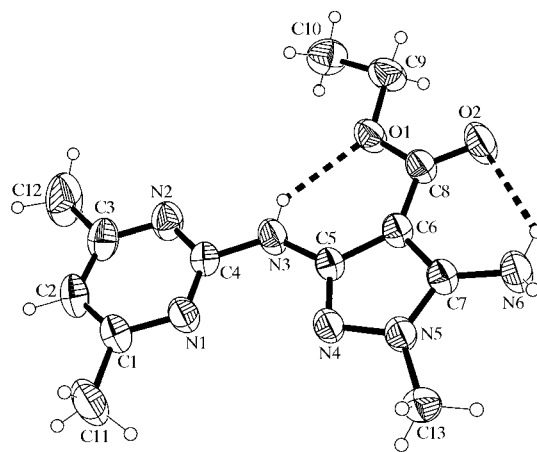


Figure 1

A view of (I), showing the atom-numbering scheme. Displacement ellipsoids are drawn at 50% probability level.

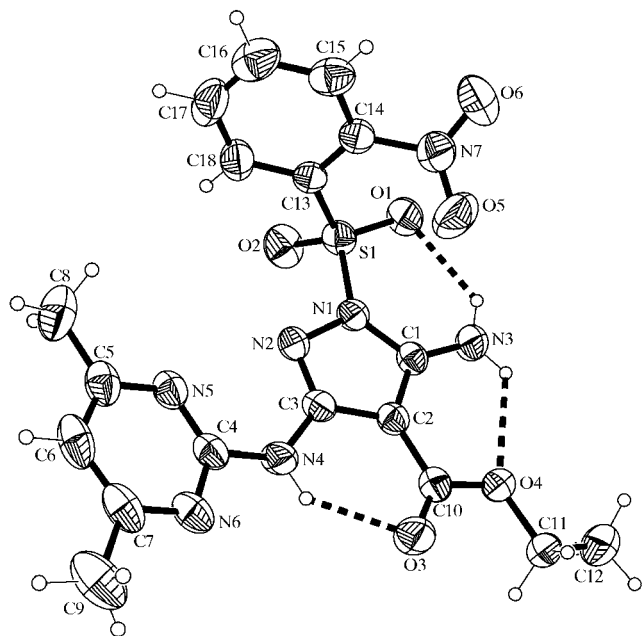


Figure 2
A view of (II), showing the atom-numbering scheme. Displacement ellipsoids are drawn at 50% probability level.

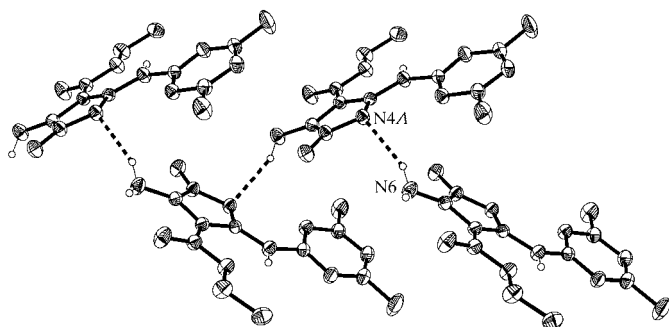


Figure 3
A packing diagram of (I), showing the intermolecular hydrogen bonds as dashed lines. [Symmetry code: (A) $2 - x, \frac{1}{2} + y, \frac{1}{2} - z$].

B' , C' and D' and the plane of pyrazole ring A' are 2.4 (5), 1.7 (6) and 4.4 (5)°, respectively. The molecular structure of (I) is stabilized by two intramolecular $N-H \cdots O$ hydrogen bonds and one intermolecular $N-H \cdots O$ hydrogen bond (Fig. 3 and Table 2). The hydrogen bonds of the molecular structure of (I) are longer than the corresponding bonds of (II), but rings A , B and C are almost coplanar. For (I) and (II), the dihedral angles between the pyrimidine and pyrazole rings are 7.9 (2) and 14.1 (1)°, respectively.

Experimental

Ethyl 5-amino-3-(4,6-dimethylpyrimidin-2-ylamino)-1*H*-pyrazole-4-carboxylate (0.69 g, 2.5 mmol) and anhydrous potassium carbonate (0.41 g, 3 mmol) were mixed in acetone (30 ml) and kept under ice-cold conditions. A solution of 2-nitrobenzene-1-sulfonyl chloride (0.66 g, 3 mmol) in acetone (5 ml) was added dropwise with stirring

for 10 min. The mixture was stirred at room temperature overnight and the solvent was then evaporated to dryness in a vacuum. The residue was washed with water. The resulting pale-yellow precipitate was filtered off and recrystallized from ethanol, whereupon well shaped crystals of (II) were obtained. Compound (I) was synthesized using the same procedure, except that iodomethane was used as the starting material instead of 2-nitrobenzenesulfonyl chloride, and the product was purified by silica column chromatography (eluant: ethyl acetate/petroleum ether 1:5) and recrystallized from ethanol. Crystals of (I) and (II) suitable for single-crystal X-ray diffraction were selected directly from the sample as prepared.

Compound (I)

Crystal data

$C_{13}H_{18}N_6O_2$
 $M_r = 290.33$
Orthorhombic, $P2_12_12_1$
 $a = 7.5466$ (15) Å
 $b = 9.042$ (2) Å
 $c = 22.412$ (8) Å
 $V = 1529.3$ (7) Å³
 $Z = 4$
 $D_x = 1.261$ Mg m⁻³

Mo $K\alpha$ radiation
Cell parameters from 825 reflections
 $\theta = 2.4$ – 25.5°
 $\mu = 0.09$ mm⁻¹
 $T = 293$ (2) K
Prism, yellow
0.38 × 0.30 × 0.20 mm

Data collection

Bruker SMART 1000 CCD area-detector diffractometer
 φ and ω scans
7861 measured reflections
1836 independent reflections
1629 reflections with $I > 2\sigma(I)$

$R_{int} = 0.048$
 $\theta_{max} = 26.5^\circ$
 $h = -5 \rightarrow 9$
 $k = -11 \rightarrow 11$
 $l = -28 \rightarrow 22$

Refinement

Refinement on F^2
 $R[F^2 > 2\sigma(F^2)] = 0.038$
 $wR(F^2) = 0.101$
 $S = 1.09$
1836 reflections
204 parameters
H atoms treated by a mixture of independent and constrained refinement

$w = 1/[\sigma^2(F_o^2) + (0.0529P)^2 + 0.2041P]$
where $P = (F_o^2 + 2F_c^2)/3$
 $(\Delta/\sigma)_{max} = 0.001$
 $\Delta\rho_{max} = 0.17$ e Å⁻³
 $\Delta\rho_{min} = -0.13$ e Å⁻³
Extinction correction: *SHELXL97*
Extinction coefficient: 0.014 (2)

Table 1

Selected geometric parameters (Å, °) for (I).

N3–C5	1.386 (3)	C5–C6	1.417 (3)
N6–C7	1.355 (3)	C6–C7	1.404 (3)
O1–C8	1.347 (3)	C6–C8	1.440 (3)
O2–C8	1.215 (3)		
N3–C5–C6	123.96 (19)	O2–C8–C6	124.9 (2)
N6–C7–C6	129.7 (2)	O1–C8–C6	112.38 (19)
O2–C8–O1	122.7 (2)		
N3–C5–C6–C8	−0.3 (4)	C7–C6–C8–O2	0.3 (4)
C8–C6–C7–N6	−2.4 (4)	C5–C6–C8–O1	−0.8 (3)

Table 2

Hydrogen-bond geometry (Å, °) for (I).

$D-H \cdots A$	$D-H$	$H \cdots A$	$D \cdots A$	$D-H \cdots A$
N3–H3 \cdots O1	0.87 (1)	2.13 (2)	2.806 (2)	135 (2)
N6–H6A \cdots N4 ⁱ	0.86 (1)	2.27 (2)	3.082 (3)	158 (3)
N6–H6B \cdots O2	0.86 (1)	2.33 (2)	2.933 (3)	128 (3)

Symmetry code: (i) $-x + 2, y + \frac{1}{2}, -z + \frac{1}{2}$.

Compound (II)

Crystal data

C₁₈H₁₉N₇O₆S
M_r = 461.46
 Monoclinic, *P*_{2₁}/*c*
a = 10.536 (2) Å
b = 13.715 (3) Å
c = 14.443 (3) Å
 β = 93.570 (8)°
V = 2083.1 (7) Å³
Z = 4

Data collection

Bruker SMART 1000 CCD area-
 detector diffractometer
 φ and ω scans
 Absorption correction: multi-scan
 (SADABS; Sheldrick, 1996)
*T*_{min} = 0.920, *T*_{max} = 0.960
 9353 measured reflections

Refinement

Refinement on *F*²
R [*F*² > 2σ(*F*²)] = 0.050
wR [*F*²] = 0.134
S = 1.04
 4118 reflections
 299 parameters
 H atoms treated by a mixture of
 independent and constrained
 refinement

D_x = 1.471 Mg m⁻³
 Mo *K*α radiation
 Cell parameters from 965
 reflections
 θ = 2.9–25.0°
 μ = 0.21 mm⁻¹
T = 293 (2) K
 Prism, yellow
 0.30 × 0.25 × 0.20 mm

4118 independent reflections
 2700 reflections with *I* > 2σ(*I*)
*R*_{int} = 0.033
 θ_{max} = 26.3°
h = -7 → 13
k = -17 → 15
l = -17 → 17

$w = 1/[\sigma^2(F_o^2) + (0.064P)^2 + 0.3838P]$
 where $P = (F_o^2 + 2F_c^2)/3$
 $(\Delta/\sigma)_{\text{max}} < 0.001$
 $\Delta\rho_{\text{max}} = 0.28 \text{ e } \text{Å}^{-3}$
 $\Delta\rho_{\text{min}} = -0.28 \text{ e } \text{Å}^{-3}$
 Extinction correction: SHELXL97
 Extinction coefficient: 0.0039 (7)

Table 3

Selected geometric parameters (Å, °) for (II).

S1–O1	1.4182 (17)	O3–C10	1.211 (3)
S1–N1	1.650 (2)	O4–C10	1.333 (3)
N1–C1	1.373 (3)	C1–C2	1.378 (3)
N3–C1	1.339 (3)	C2–C10	1.441 (3)
N4–C3	1.380 (3)		
O1–S1–N1	105.81 (10)	N4–C3–C2	121.1 (2)
N3–C1–N1	123.5 (2)	O3–C10–C2	123.8 (2)
N3–C1–C2	131.1 (2)	O4–C10–C2	113.2 (2)
O1–S1–N1–C1	-7.5 (3)	C1–C2–C10–O4	-6.7 (4)
S1–N1–C1–N3	-2.3 (4)	C3–C2–C10–O4	173.9 (2)
N3–C1–C2–C10	1.7 (5)	O5–N7–C14–C13	-48.6 (4)
C10–C2–C3–N4	-0.1 (4)		

H atoms attached to C atoms were included in calculated positions and treated as riding atoms using SHELXL97 default parameters [*C*–H = 0.93, 0.96 or 0.97 Å, and *U*_{iso}(H) = 1.2*U*_{eq}(C) or 1.5*U*_{eq}(C methyl)]. For (I), the H atoms on atoms N3 and N6 were located from

Table 4

Hydrogen-bond geometry (Å, °) for (II).

<i>D</i> –H··· <i>A</i>	<i>D</i> –H	H··· <i>A</i>	<i>D</i> ··· <i>A</i>	<i>D</i> –H··· <i>A</i>
N3–H3A···O1	0.87 (1)	2.14 (2)	2.789 (3)	131 (2)
N3–H3B···O4	0.86 (1)	2.30 (2)	2.881 (3)	125 (2)
N4–H4A···O3	0.87 (1)	2.06 (2)	2.769 (3)	138 (2)

difference Fourier maps and refined isotropically, with the N–H distances restrained to 0.86 (1) Å. For (II), the H atoms on atoms N3 and N4 were located from difference Fourier maps and refined isotropically, with the N–H distances restrained to 0.87 (1) Å.

For both compounds, data collection: SMART (Bruker, 1998); cell refinement: SMART; data reduction: SAINT (Bruker, 1999); structure solution: SHELXS97 (Sheldrick, 1997); structure refinement: SHELXL97 (Sheldrick, 1997); molecular graphics: SHELXTL (Bruker, 1999); publication software: SHELXTL.

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Supplementary data for this paper are available from the IUCr electronic archives (Reference: AV1221). Services for accessing these data are described at the back of the journal.

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