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2-Acetylhydrazono-2-phenylaceto-
hydrazideBai-Cheng Feng,^{a*} Zhi Yang^b and Xu Yi^b^aCollege of Chemical Engineering, Qingdao University of Science and Technology, Qingdao 266042, People's Republic of China, and ^bCollege of Chemistry and Molecular Engineering, Qingdao University of Science and Technology, Qingdao 266042, People's Republic of China

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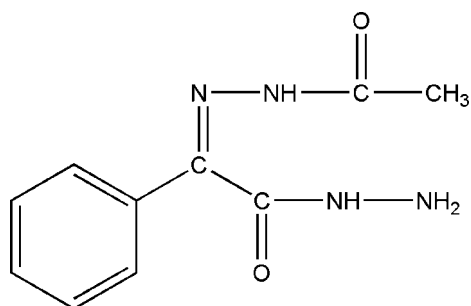
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Key indicators: single-crystal X-ray study; $T = 153$ K; mean $\sigma(\text{C}-\text{C}) = 0.002$ Å; R factor = 0.036; wR factor = 0.104; data-to-parameter ratio = 12.1.

The title compound, $\text{C}_{10}\text{H}_{12}\text{N}_4\text{O}_2$, was prepared as an intermediate for the synthesis of metamitron. The benzene ring plane forms dihedral angles of 66.0 (1) and 3.5 (5) $^\circ$ with the hydrazine plane and the acetylimino plane, respectively. The crystal structure involves intermolecular $\text{N}-\text{H}\cdots\text{O}$ hydrogen bonds.

Related literature

For related literature on the biological activity, see: Javier *et al.* (2006). For a similar structure, see: Glaser *et al.* (1993). For the preparation, see: Pan *et al.* (2007).



Experimental

Crystal data

$\text{C}_{10}\text{H}_{12}\text{N}_4\text{O}_2$
 $M_r = 220.24$
 Monoclinic, $P2_1/c$
 $a = 12.737$ (3) Å
 $b = 4.5867$ (10) Å
 $c = 21.002$ (7) Å
 $\beta = 117.62$ (2) $^\circ$
 $V = 1087.1$ (5) Å³
 $Z = 4$
 Mo $K\alpha$ radiation
 $\mu = 0.10$ mm⁻¹
 $T = 153$ (2) K
 $0.42 \times 0.31 \times 0.22$ mm

Data collection

Rigaku R-Axis RAPID IP area-detector diffractometer
 Absorption correction: multi-scan (ABSCOR; Higashi 1995)
 $T_{\min} = 0.804$, $T_{\max} = 0.979$
 7793 measured reflections
 1878 independent reflections
 1624 reflections with $I > 2\sigma(I)$
 $R_{\text{int}} = 0.024$

Refinement

$R[F^2 > 2\sigma(F^2)] = 0.035$
 $wR(F^2) = 0.103$
 $S = 1.08$
 1878 reflections
 155 parameters
 H atoms treated by a mixture of independent and constrained refinement
 $\Delta\rho_{\max} = 0.20$ e Å⁻³
 $\Delta\rho_{\min} = -0.16$ e Å⁻³

Table 1

Hydrogen-bond geometry (Å, $^\circ$).

$D-H\cdots A$	$D-H$	$H\cdots A$	$D\cdots A$	$D-H\cdots A$
$\text{N2}-\text{H2B}\cdots\text{O2}^{\text{i}}$	0.88	2.09	2.9512 (16)	167
$\text{N3}-\text{H3B}\cdots\text{O1}^{\text{ii}}$	0.88	2.08	2.8450 (15)	145
$\text{N4}-\text{H4B}\cdots\text{O2}^{\text{i}}$	0.90 (2)	2.396 (19)	3.0903 (19)	134.5 (15)
$\text{N4}-\text{H4C}\cdots\text{O1}^{\text{iii}}$	0.890 (18)	2.274 (18)	3.0514 (19)	145.8 (15)

Symmetry codes: (i) $-x + 1, -y + 2, -z + 1$; (ii) $x, y - 1, z$; (iii) $-x + 1, y - \frac{1}{2}, -z + \frac{1}{2}$.

Data collection: *RAPID-AUTO* (Rigaku, 2004); cell refinement: *RAPID-AUTO*; data reduction: *RAPID-AUTO*; program(s) used to solve structure: *SHELXTL* (Sheldrick, 2008); program(s) used to refine structure: *SHELXTL*; molecular graphics: *SHELXTL*; software used to prepare material for publication: *SHELXTL*.

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: BV2104).

References

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supporting information

Acta Cryst. (2008). E64, o1828 [doi:10.1107/S160053680802624X]

2-Acetylhydrazono-2-phenylacetohydrazide

Bai-Cheng Feng, Zhi Yang and Xu Yi

S1. Comment

Metamitron (Trade name: Goltix) is used against grass and broad-leaved weeds in sugar and fodder beets. Metamitron is applied pre-drilling and pre- and post-emergence (post-emergence as sequential treatment tank-mixed with oil or other herbicides). Metamitron is also used in mangold, red beet and certain strawberry varieties. The dose rates for metamitron are 0.35–4.2 kg active ingredient/ha for all crops. The currently used weed control strategy in sugarbeet involves a mixture of herbicides (phenmedipham, ethofumesate, metamitron, chloridazon *etc*) to control dicotyledonous weeds. Wettable powder (70%) has been used for the control of morel goosefoot chickweed *Lamium barbatum etc*. Metamitron can be used before and after planting. It can be applied to the control of the entire crop growing period with better efficacy when it cooperates with others herbicides and pesticides (Javier *et al.*, 2006).

The title compound (I) was synthesized as an intermediate for the synthesis of metamitron. We report here the crystal structure of (I).

In (I) (Fig. 1), all bond lengths and angles are normal and in a good agreement with those reported previously (Glaser *et al.*, 1993). The benzene ring plane forms dihedral angles of 66.0 (1)° and 3.5 (5)° with the hydrazine plane consisting of O1, N3, N4, and C8, and the acetylimino plane consisting of O2, N1, N2, C9, and C10, respectively. The crystal structure is stabilized by intermolecular N–H–O hydrogen bonds.

S2. Experimental

Phenylglyoxylic acid ethyl ester 2-acetylhydrazone 23.4 g (0.1 mol), was dissolved in 100 ml ethanol in a flask equipped with stirrer and reflux condenser. Hydrazine hydrate 7.5 g (0.1 mmol) was slowly added from a dropping-funnel during 30 minutes while maintaining the temperature at 25–30°C for two hours. Portions of the solvent were distilled and the remaining solution cooled in ice water. White crystals separated out after a short time (18.9 g, yield 87.3%) (Pan *et al.*, 2007). Single crystals suitable for X-ray measurement were obtained by recrystallization from petrol ether at room temperature.

S3. Refinement

All H atoms were found on difference maps. The hydrazine H atoms were refined freely, giving an N–H bond distance of 0.89 or 0.90 Å. The remaining H atoms were positioned geometrically [N–H = 0.88 Å C–H = 0.95 Å (CH), C–H = 0.98 Å (CH₃), and $U_{\text{iso}}(\text{H}) = 1.5$ times (Methyl) or $U_{\text{iso}}(\text{H}) = 1.2$ times (other H atoms)].

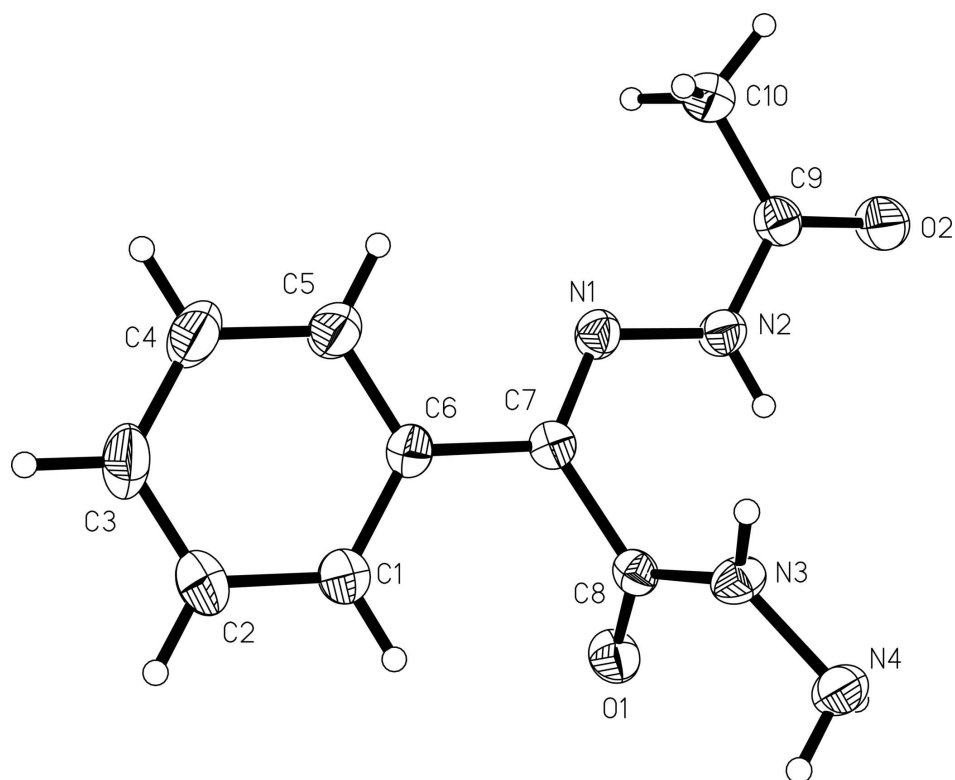


Figure 1

View of the title compound (I), with displacement ellipsoids drawn at the 35% probability level.

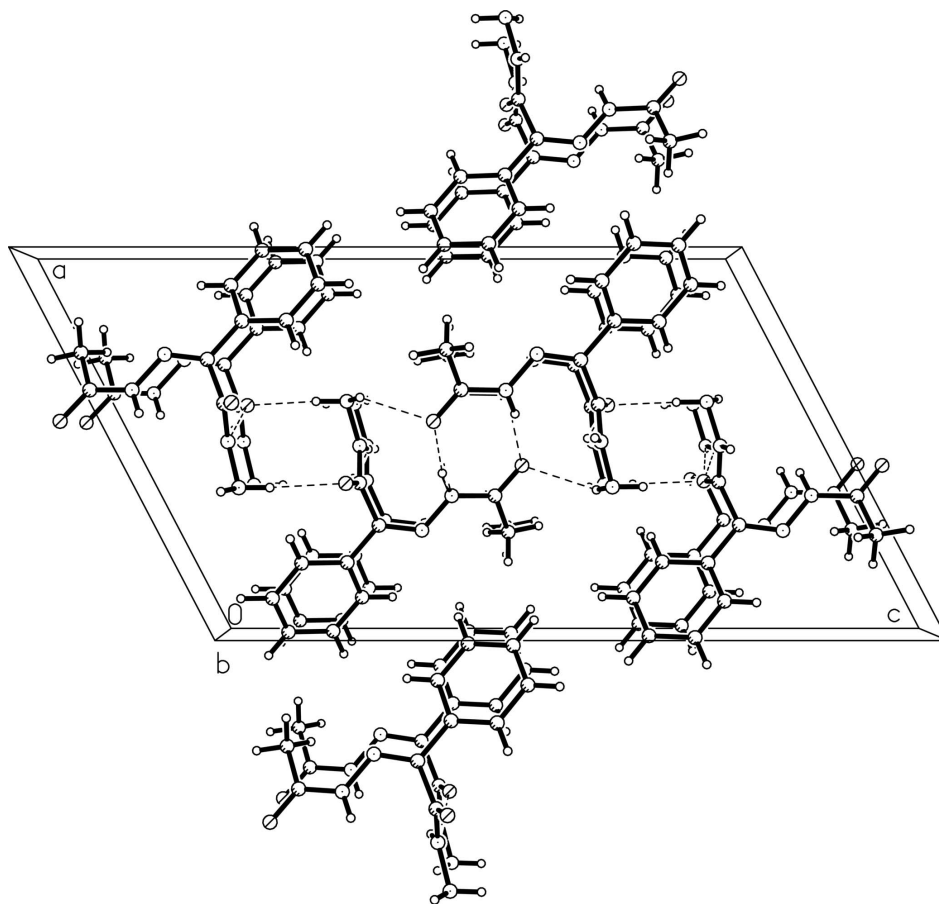


Figure 2

A packing diagram of the molecule of the title compound, view down *b* axis. Hydrogen bonds are shown as dashed lines.

2-Acetylhydrazone-2-phenylacetohydrazide

Crystal data

$C_{10}H_{12}N_4O_2$

$M_r = 220.24$

Monoclinic, $P2_1/c$

Hall symbol: $-P\ 2_1/c$

$a = 12.737\ (3)\ \text{\AA}$

$b = 4.5867\ (10)\ \text{\AA}$

$c = 21.002\ (7)\ \text{\AA}$

$\beta = 117.62\ (2)^\circ$

$V = 1087.1\ (5)\ \text{\AA}^3$

$Z = 4$

$F(000) = 464$

$D_x = 1.346\ \text{Mg m}^{-3}$

Mo $K\alpha$ radiation, $\lambda = 0.71073\ \text{\AA}$

Cell parameters from 2652 reflections

$\theta = 2.6\text{--}25.6^\circ$

$\mu = 0.10\ \text{mm}^{-1}$

$T = 153\ \text{K}$

Block, colorless

$0.42 \times 0.31 \times 0.22\ \text{mm}$

Data collection

Rigaku R-AXIS RAPID IP area-detector
diffractometer

Radiation source: Rotating Anode

Graphite monochromator

ω Oscillation scans

Absorption correction: multi-scan
(*ABSCOR*; Higashi 1995)

$T_{\min} = 0.805$, $T_{\max} = 0.979$

7793 measured reflections

1878 independent reflections

1624 reflections with $I > 2\sigma(I)$

$R_{\text{int}} = 0.024$
 $\theta_{\text{max}} = 25.0^\circ$, $\theta_{\text{min}} = 3.2^\circ$
 $h = -15 \rightarrow 15$

$k = -5 \rightarrow 5$
 $l = -24 \rightarrow 24$

Refinement

Refinement on F^2
 Least-squares matrix: full
 $R[F^2 > 2\sigma(F^2)] = 0.035$
 $wR(F^2) = 0.103$
 $S = 1.08$
 1878 reflections
 155 parameters
 0 restraints
 Primary atom site location: structure-invariant
 direct methods
 Secondary atom site location: difference Fourier
 map

Hydrogen site location: inferred from
 neighbouring sites
 H atoms treated by a mixture of independent
 and constrained refinement
 $w = 1/[\sigma^2(F_o^2) + (0.0567P)^2 + 0.2207P]$
 where $P = (F_o^2 + 2F_c^2)/3$
 $(\Delta/\sigma)_{\text{max}} = 0.001$
 $\Delta\rho_{\text{max}} = 0.20 \text{ e } \text{\AA}^{-3}$
 $\Delta\rho_{\text{min}} = -0.16 \text{ e } \text{\AA}^{-3}$
 Extinction correction: *SHELXTL* (Sheldrick,
 2008), $F_c^* = kF_c[1 + 0.001x F_c^2 \lambda^3 / \sin(2\theta)]^{-1/4}$
 Extinction coefficient: 0.024 (4)

Special details

Geometry. All e.s.d.'s (except the e.s.d. in the dihedral angle between two l.s. planes) are estimated using the full covariance matrix. The cell e.s.d.'s are taken into account individually in the estimation of e.s.d.'s in distances, angles and torsion angles; correlations between e.s.d.'s in cell parameters are only used when they are defined by crystal symmetry. An approximate (isotropic) treatment of cell e.s.d.'s is used for estimating e.s.d.'s involving l.s. planes.

Refinement. Refinement of F^2 against ALL reflections. The weighted R -factor wR and goodness of fit S are based on F^2 , conventional R -factors R are based on F , with F set to zero for negative F^2 . The threshold expression of $F^2 > \sigma(F^2)$ is used only for calculating R -factors(gt) *etc.* and is not relevant to the choice of reflections for refinement. R -factors based on F^2 are statistically about twice as large as those based on F , and R -factors based on ALL data will be even larger.

Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters (\AA^2)

	x	y	z	$U_{\text{iso}}^*/U_{\text{eq}}$
O1	0.40065 (9)	1.19619 (19)	0.29348 (5)	0.0427 (3)
O2	0.44401 (10)	0.7702 (2)	0.54459 (5)	0.0531 (3)
N1	0.27633 (9)	0.7290 (2)	0.35864 (6)	0.0362 (3)
N2	0.36620 (10)	0.8004 (3)	0.42552 (6)	0.0390 (3)
H2B	0.4245	0.9138	0.4292	0.047*
N3	0.49466 (9)	0.7681 (2)	0.33409 (6)	0.0359 (3)
H3B	0.4858	0.5829	0.3415	0.043*
N4	0.60867 (10)	0.8674 (3)	0.34944 (7)	0.0423 (3)
C1	0.19350 (13)	0.8340 (4)	0.17011 (7)	0.0469 (4)
H1A	0.2573	0.9530	0.1742	0.056*
C2	0.10157 (15)	0.7697 (4)	0.10282 (8)	0.0573 (4)
H2A	0.1027	0.8455	0.0610	0.069*
C3	0.00929 (13)	0.5978 (4)	0.09616 (8)	0.0585 (5)
H3A	-0.0536	0.5542	0.0499	0.070*
C4	0.00809 (14)	0.4882 (4)	0.15689 (9)	0.0634 (5)
H4A	-0.0560	0.3691	0.1524	0.076*
C5	0.09888 (13)	0.5496 (4)	0.22391 (8)	0.0517 (4)
H5A	0.0975	0.4711	0.2654	0.062*
C6	0.19282 (11)	0.7257 (3)	0.23147 (7)	0.0348 (3)
C7	0.28992 (11)	0.7937 (3)	0.30347 (6)	0.0321 (3)

C8	0.40034 (10)	0.9387 (3)	0.30915 (6)	0.0301 (3)
C9	0.36513 (12)	0.6973 (3)	0.48520 (7)	0.0378 (3)
C10	0.26833 (13)	0.4954 (4)	0.47702 (8)	0.0514 (4)
H10A	0.2836	0.4216	0.5243	0.077*
H10B	0.2650	0.3317	0.4462	0.077*
H10C	0.1926	0.5998	0.4552	0.077*
H4C	0.6083 (14)	0.900 (4)	0.3076 (10)	0.055 (5)*
H4B	0.6174 (15)	1.039 (4)	0.3717 (9)	0.061 (5)*

Atomic displacement parameters (Å²)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
O1	0.0494 (6)	0.0282 (5)	0.0425 (5)	-0.0037 (4)	0.0144 (4)	0.0028 (4)
O2	0.0597 (7)	0.0632 (7)	0.0316 (5)	-0.0165 (5)	0.0171 (5)	-0.0079 (5)
N1	0.0332 (6)	0.0421 (7)	0.0320 (6)	-0.0033 (4)	0.0138 (5)	-0.0042 (5)
N2	0.0379 (6)	0.0480 (7)	0.0313 (6)	-0.0107 (5)	0.0162 (5)	-0.0060 (5)
N3	0.0363 (6)	0.0275 (5)	0.0472 (6)	-0.0034 (4)	0.0220 (5)	0.0000 (5)
N4	0.0367 (6)	0.0480 (8)	0.0463 (7)	-0.0055 (5)	0.0227 (5)	-0.0012 (6)
C1	0.0449 (8)	0.0560 (9)	0.0371 (7)	-0.0082 (7)	0.0166 (6)	-0.0022 (7)
C2	0.0578 (10)	0.0741 (12)	0.0323 (7)	-0.0047 (8)	0.0144 (7)	-0.0015 (7)
C3	0.0421 (9)	0.0794 (12)	0.0399 (8)	-0.0050 (8)	0.0070 (6)	-0.0153 (8)
C4	0.0437 (9)	0.0879 (13)	0.0532 (9)	-0.0243 (8)	0.0180 (7)	-0.0173 (9)
C5	0.0452 (8)	0.0679 (11)	0.0417 (7)	-0.0158 (7)	0.0200 (6)	-0.0075 (7)
C6	0.0316 (7)	0.0370 (7)	0.0339 (7)	0.0014 (5)	0.0136 (5)	-0.0044 (5)
C7	0.0343 (7)	0.0295 (7)	0.0323 (6)	0.0009 (5)	0.0155 (5)	-0.0023 (5)
C8	0.0364 (7)	0.0274 (7)	0.0249 (6)	-0.0032 (5)	0.0128 (5)	-0.0041 (5)
C9	0.0406 (7)	0.0401 (8)	0.0331 (7)	0.0008 (6)	0.0176 (6)	-0.0023 (6)
C10	0.0490 (9)	0.0602 (10)	0.0434 (8)	-0.0078 (7)	0.0200 (7)	0.0072 (7)

Geometric parameters (Å, °)

O1—C8	1.2263 (15)	C2—C3	1.368 (2)
O2—C9	1.2308 (17)	C2—H2A	0.9500
N1—C7	1.2833 (17)	C3—C4	1.378 (2)
N1—N2	1.3783 (16)	C3—H3A	0.9500
N2—C9	1.3455 (18)	C4—C5	1.374 (2)
N2—H2B	0.8800	C4—H4A	0.9500
N3—C8	1.3218 (16)	C5—C6	1.391 (2)
N3—N4	1.4093 (15)	C5—H5A	0.9500
N3—H3B	0.8800	C6—C7	1.4762 (18)
N4—H4C	0.890 (18)	C7—C8	1.5097 (17)
N4—H4B	0.90 (2)	C9—C10	1.487 (2)
C1—C6	1.385 (2)	C10—H10A	0.9800
C1—C2	1.386 (2)	C10—H10B	0.9800
C1—H1A	0.9500	C10—H10C	0.9800
C7—N1—N2	117.99 (11)	C4—C5—C6	120.46 (15)
C9—N2—N1	120.24 (11)	C4—C5—H5A	119.8

C9—N2—H2B	119.9	C6—C5—H5A	119.8
N1—N2—H2B	119.9	C1—C6—C5	118.57 (12)
C8—N3—N4	123.36 (11)	C1—C6—C7	120.92 (12)
C8—N3—H3B	118.3	C5—C6—C7	120.51 (12)
N4—N3—H3B	118.3	N1—C7—C6	118.45 (12)
N3—N4—H4C	107.2 (11)	N1—C7—C8	122.77 (11)
N3—N4—H4B	105.6 (11)	C6—C7—C8	118.78 (11)
H4C—N4—H4B	108.0 (16)	O1—C8—N3	124.14 (12)
C6—C1—C2	120.39 (14)	O1—C8—C7	121.45 (11)
C6—C1—H1A	119.8	N3—C8—C7	114.37 (10)
C2—C1—H1A	119.8	O2—C9—N2	119.50 (13)
C3—C2—C1	120.44 (15)	O2—C9—C10	122.00 (12)
C3—C2—H2A	119.8	N2—C9—C10	118.49 (12)
C1—C2—H2A	119.8	C9—C10—H10A	109.5
C2—C3—C4	119.58 (14)	C9—C10—H10B	109.5
C2—C3—H3A	120.2	H10A—C10—H10B	109.5
C4—C3—H3A	120.2	C9—C10—H10C	109.5
C5—C4—C3	120.55 (15)	H10A—C10—H10C	109.5
C5—C4—H4A	119.7	H10B—C10—H10C	109.5
C3—C4—H4A	119.7		
C7—N1—N2—C9	-169.43 (11)	C5—C6—C7—N1	-11.5 (2)
C6—C1—C2—C3	-0.2 (3)	C1—C6—C7—C8	-10.55 (19)
C1—C2—C3—C4	0.0 (3)	C5—C6—C7—C8	169.07 (13)
C2—C3—C4—C5	-0.2 (3)	N4—N3—C8—O1	3.72 (19)
C3—C4—C5—C6	0.6 (3)	N4—N3—C8—C7	-174.25 (11)
C2—C1—C6—C5	0.7 (2)	N1—C7—C8—O1	-106.29 (15)
C2—C1—C6—C7	-179.71 (14)	C6—C7—C8—O1	73.11 (15)
C4—C5—C6—C1	-0.9 (2)	N1—C7—C8—N3	71.75 (15)
C4—C5—C6—C7	179.52 (15)	C6—C7—C8—N3	-108.85 (13)
N2—N1—C7—C6	-178.31 (11)	N1—N2—C9—O2	-177.76 (12)
N2—N1—C7—C8	1.09 (19)	N1—N2—C9—C10	2.8 (2)
C1—C6—C7—N1	168.88 (13)		

Hydrogen-bond geometry (\AA , $^\circ$)

<i>D</i> —H \cdots <i>A</i>	<i>D</i> —H	H \cdots <i>A</i>	<i>D</i> \cdots <i>A</i>	<i>D</i> —H \cdots <i>A</i>
N2—H2B \cdots O2 ⁱ	0.88	2.09	2.9512 (16)	167
N3—H3B \cdots O1 ⁱⁱ	0.88	2.08	2.8450 (15)	145
N4—H4B \cdots O2 ⁱ	0.90 (2)	2.396 (19)	3.0903 (19)	134.5 (15)
N4—H4C \cdots O1 ⁱⁱⁱ	0.890 (18)	2.274 (18)	3.0514 (19)	145.8 (15)

Symmetry codes: (i) $-x+1, -y+2, -z+1$; (ii) $x, y-1, z$; (iii) $-x+1, y-1/2, -z+1/2$.