SYNTHESIS, SPECTRAL PROPERTIES, AND PESTICIDAL ACTIVITY OF 4-AMINO(ALKYLAMINO, DIALKYLAMINO)-5-CHLORO--2-SUBSTITUTED-3-OXO-2*H*-PYRIDAZINES AND 5-AMINO(ALKYLAMINO, DIALKYLAMINO)-4-CHLORO--2-SUBSTITUTED-3-OXO-2*H*-PYRIDAZINES

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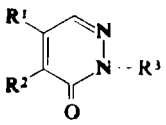
4-Amino(alkylamino)-5-chloro-2-substituted-3-oxo-2*H*-pyridazines and 5-amino(alkylamino, dialkylamino)-4-chloro-2-substituted-3-oxo-2*H*-pyridazines have been prepared by nucleophilic substitution reactions of 4,5-dichloro-2-substituted-3-oxo-2*H*-pyridazines with amines in aprotic solvent. Structure of the compounds prepared has been proved by IR and UV spectra. Fungicidal and herbicidal activity of the compounds prepared have been tested. None of the compounds prepared exceeds the standard Vitavax in the fungicidal activity tests. Compounds *VIII* and *XII* show equal or better activity on the Hill reaction as compared with the standard pyrazone.

One of the most frequently used herbicides for sugar beet plantations is 5-amino-4-chloro-3-oxo--2-phenyl-2*H*-pyridazine (pyrazone)[1] which is produced by action of methanolic ammonia on 4,5-dichloro-3-oxo-2-phenyl-2*H*-pyridazine under enhanced pressure[2]; the reaction also produces up to 15% of the inactive isomer 4-amino-5-chloro-3-oxo-2-phenyl-2*H*-pyridazine and up to 10% of 4-chloro-5-hydroxy-3-oxo-2-phenyl-2*H*-pyridazine.

The aim of this communication is a study of nucleophilic substitution reactions of 4,5-dichloro-2-substituted-3-oxo-2*H*-pyridazines with various amines in aprotic organic solvent. The compounds prepared were studied with respect to their IR and UV spectra, fungicidal activity, and effect on the Hill reaction in comparison with pyrazone; the compounds with high effects on the Hill reaction were tested for herbicidal activity at glass-house conditions. The nucleophilic substitution reactions of 4,5-dichloro-2-substituted-3-oxo-2*H*-pyridazines with amines in aprotic solvent (not described in literature yet) give the both isomers *A* and *B*. The isomers 4-amino(alkylamino, dialkylamino)-5-chloro-2-substituted-3-oxo-2*H*-pyridazines (*A*) and 5-amino(alkylamino, dialkylamino)-4-chloro-2-substituted-3-oxo-2*H*-pyridazines (*B*) were isolated from the syntheses.

The synthetized 4-amino(alkylamino, dialkylamino)-5-chloro-2-substituted-3-oxo--2*H*-pyridazines (*I*–*XIX*) are given in Table I and their IR and UV spectral data



A, $R^1 = Cl$

	R^2	R^3		R^2	R^3
I	NH_2	CH_3	*XI*	$C_6H_{11}NH$	C_6H_5
II	CH_3NH_2	CH_3	*XII*	$(CH_3)_2N$	C_6H_5
III	$(CH_3)_2CHCH_2NH$	CH_3	*XIII*		C_6H_5
IV	$C_6H_{11}NH$	CH_3	*XIV*		$CH_2C_6H_5$
V	$(CH_3)_2N$	CH_3			
VI		CH_3	*XV*	CH_3NH	$3\text{-}CF_3C_6H_4$
VII	NH_2	C_6H_5	*XVI*	CH_3NH	C_2H_5
VIII	CH_3NH	C_6H_5	*XVII*	CH_3NH	C_6H_{11}
IX	C_4H_9NH	C_6H_5	*XVIII*	$(C_2H_5)_2N$	C_3H_7
X	$CH_3O(CH_2)_2NH$	C_6H_5	*XIX*		CH_3

B, $R^2 = Cl$

	R^1	R^3		R^1	R^3
XX	NH_2	CH_3	*XXIX*	$CH_3O(CH_2)_2NH$	C_6H_5
XXI	CH_3NH	CH_3	*XXX*	$C_6H_{11}NH$	C_6H_5
XXII	$(CH_3)_2CHCH_2NH$	CH_3	*XXXI*	$(CH_3)_2N$	C_6H_5
XXIII	$C_6H_{11}NH$	CH_3	*XXXII*		C_6H_5
XXIV	$(CH_3)_2N$	CH_3			
XXV		CH_3	*XXXIII*		$CH_2C_6H_5$
XXVI	NH_2	C_6H_5	*XXXIV*	CH_3NH	$3\text{-}CF_3C_6H_4$
XXVII	CH_3NH_2	C_6H_5	*XXXV*	CH_3NH	C_2H_5
XXVIII	C_4H_9NH	C_6H_5	*XXXVI*	CH_3NH	C_6H_{11}
			XXXVI		CH_3

in Table II. The IR spectra of these compounds show two bands $\nu(NH)$ in the region of $3\,000-3\,400\ cm^{-1}$. The bands at lower wave numbers can be assigned to the N H bond vibrations involved in the intramolecular hydrogen bond with the oxygen atom of the carbonyl group, whereas those at higher wave numbers are due to the vibrations of the N H bonds involved in the hydrogen bond with chlorine.

TABLE I
Compounds prepared

Compound	Formula (m.w.)	Calculated/Found		M.p., °C/B.p., °C/Pa (yield, %)
		% N	% Cl	
I	$C_5H_6ClN_3O$ (159·6)	26·32 26·51	22·22 22·31	108—110 (16)
II	$C_6H_8ClN_3O$ (173·8)	24·18 24·06	20·39 20·50	134—135 (43)
III	$C_9H_{14}ClN_3O$ (215·7)	19·48 19·52	16·44 16·37	85—87 (42)
IV	$C_{11}H_{16}ClN_3O$ (241·7)	17·39 17·31	14·67 14·60	33—35 (40)
V	$C_7H_{10}ClN_3O$ (188·0)	22·36 22·19	18·56 18·49	28—29 (51)
VI	$C_{10}H_{14}ClN_3O$ (227·7)	18·46 18·53	15·57 15·61	133/66·5 (46)
VII	$C_{10}H_8ClN_3O$ (221·6)	18·97 19·11	15·99 16·01	140—141 (20)
VIII	$C_{11}H_{10}ClN_3O$ (235·8)	17·82 17·98	15·03 15·00	115—117 (59)
IX	$C_{14}H_{16}ClN_3O$ (277·7)	15·14 15·11	12·77 12·90	55—56 (35)
X	$C_{13}H_{14}ClN_3O_2$ (279·7)	15·03 15·00	12·67 12·76	69—71 (32)
XI	$C_{16}H_{18}ClN_3O_2$ (303·8)	13·83 14·00	11·67 11·90	42—44 (54)
XII	$C_{12}H_{12}ClN_3O$ (250·0)	16·81 16·91	14·18 14·22	79—80 (36)
XIII	$C_{14}H_{14}ClN_3O$ (275·7)	15·24 15·19	12·86 12·94	92—93 (53)
XIV	$C_{15}H_{16}ClN_3O$ (289·7)	14·51 14·56	12·24 12·19	85—87 (42)
XV[a]	$C_{12}H_9F_3ClN_3O$ (303·7)	13·84 13·90	11·67 11·84	142—143 (27)
XVI	$C_7H_{10}ClN_3O$ (188·0)	22·36 22·41	18·56 18·61	74—76 (35)
XVII	$C_{11}H_{16}ClN_3O$ (241·7)	17·39 17·43	14·67 14·88	113—115 (50)
XVIII	$C_{11}H_{18}ClN_3O$ (243·7)	17·25 17·41	14·55 14·60	112/2·6 (58)
XIX	$C_9H_{12}ClN_3O$ (213·7)	19·67 19·72	16·59 16·49	110/6·6 (32)

TABLE I
(*Continued*)

Compound	Formula (m.w.)	Calculated/Found		M.p., °C/B.p., °C/Pa (yield, %)
		% N	% Cl	
XX[b]	$C_5H_6ClN_3O$ (159·6)	26·32 26·40	22·22 22·20	203—205 (64)
XXI	$C_6H_8ClN_3O$ (173·8)	24·18 24·10	20·39 20·49	154—155 (20)
XXII	$C_9H_{14}ClN_3O$ (215·7)	19·48 19·60	16·44 16·51	123—125 (20)
XXIII	$C_{11}H_{16}ClN_3O$ (241·7)	17·39 17·42	14·67 14·58	87—88 (23)
XXIV	$C_7H_{10}ClN_3O$ (188·0)	22·36 22·40	18·56 18·61	74—75 (35)
XXV	$C_{10}H_{14}ClN_3O$ (227·7)	18·46 18·44	15·57 15·68	57—59 (19)
XXVI[b]	$C_{10}H_8ClN_3O$ (221·6)	18·97 19·01	15·99 15·81	204—205 (65)
XXVII[c]	$C_{11}H_{10}ClN_3O$ (235·8)	17·82 17·80	15·03 15·11	213—215 (26)
XXVIII	$C_{14}H_{16}ClN_3O$ (277·7)	15·14 15·10	12·77 12·84	81—83 (28)
XXIX	$C_{13}H_{14}ClN_3O$ (279·7)	15·03 15·12	12·67 12·79	106—107 (25)
XXX[c]	$C_{16}H_{18}ClN_2O$ (303·8)	13·83 14·11	11·67 11·81	56—67 (44)
XXXI[c]	$C_{12}H_{12}ClN_3O$ (250·0)	16·81 16·80	14·18 14·11	98—100 (28)
XXXII[b]	$C_{14}H_{14}ClN_3O$ (275·7)	15·24 15·21	12·86 12·81	146—147 (18)
XXXIII	$C_{15}H_{16}ClN_3O$ (289·7)	14·51 14·49	12·24 12·36	122—124 (40)
XXXIV[d]	$C_{12}H_9F_3ClN_3O$ (303·7)	13·84 13·81	11·67 11·79	142—143 (19)
XXXV	$C_7H_{10}ClN_3O$ (188·0)	22·36 22·30	18·56 18·80	166—167 (29)
XXXVI	$C_{11}H_{16}ClN_3O$ (241·7)	17·39 17·30	14·67 14·51	197—198 (18)
XXXVII	$C_9H_{12}ClN_3O$ (213·7)	19·67 19·80	16·59 16·60	76—77 (29)

[a] Calculated: 18·77% F; found: 19·01% F; [b] described in ref.[13]; [c] described in ref.[14]; [d] calculated: 19·77% F; found: 18·83% F.

TABLE II

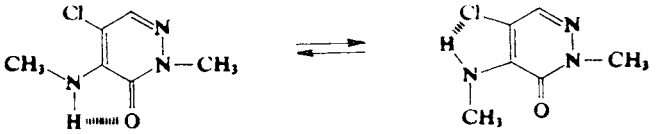
Spectral Data and Activities of Synthetized Compounds

No	IR, $\tilde{\nu}$, cm^{-1}			UV, λ_{max}, nm log ε			TF[a]	IHR[b]
	ν(C=O)	ν(NH···O=C)	ν(NH···Cl)					
I[c]	1 613	3 316	3 393	—	222 4·13	293 4·03	1	0·01
II	1 635	3 313	3 364	207 3·99	229 3·98	302 4·14	1	0·0
III	1 624	3 302	3 340	208 4·01	229 4·06	301 4·16	2	0·1
IV	1 624	3 300	3 340	207 3·93	230 3·89	302 4·10	2	0·5
V	1 637	—	—	211 4·15	246 3·70	335 4·01	1	0·005
VI	1 640	—	—	209 4·14	251 3·63	342 4·03	2	0·01
VII[d]	1 624	3 320	3 393	208 4·16	234 4·24	300 4·03	1	0·01
VIII	1 657	3 311	3 357	209 4·23	241 4·12	310 4·10	2	0·5—1
IX	1 659	3 302	3 340	208 4·16	242 4·10	309 4·09	2	0·5
X	1 655	3 300	3 329	208 4·16	241 4·10	308 4·09	2	0·1
XI	1 657	3 308	3 340	208 4·24	242 4·12	310 4·15	2	0·5
XII	1 659	—	—	208 4·26	256 3·92	343 4·03	2	1
XIII	1 651	—	—	209 4·21	253 3·91	340 4·11	2	0·1—0·05
XIV	1 637	—	—	209 4·27	244 3·87	335 4·15	2	0·1
XV	1 638	3 327	3 360	209 4·17	243 4·20	315 4·11	1	0·01
XVI	1 628	3 311	3 357	207 4·01	230 3·99	302 4·10	2	0·01
XVII	1 615	3 300	3 356	208 4·05	231 4·06	302 4·12	1	0·1

TABLE II
(*Continued*)

No	IR, $\tilde{\nu}$, cm^{-1}			UV, λ_{max}, nm log ε			TF[a]	IHR[b]
	ν(C=O)	ν(NH···O=C)	ν(NH···Cl)					
XVIII	1 643	—	—	212 4·24	253 3·57	342 3·76	2	0·1
XIX	1 643	—	—	210 4·11	242 3·72	332 4·09	2	0·5
Vitavax[c]	—	—	—	—	—	—	—	—

[a] Test on *Tilletia foetida*; [b] inhibition of the Hill reaction; [c] $\nu_{as}(NH_2)$ 3 514 cm^{-1}; [d] $\nu_{as}(NH_2)$ 3 513 cm^{-1}; [e] standard.



Very strong ν(C=O) bands are in the region of 1 613–1 659 cm^{-1} which indicate that wave numbers of these bands are influenced mainly by intramolecular hydrogen bond and by character of the R^1 and R^2 substituents. The highest wave numbers of the bands are observed in the spectra of the compounds containing the phenyl group bound to the nitrogen atom at 2-position of the pyridazine ring (*VII*–*XIII*, *XV*). The phenyl group is rotated out of the plane of the pyridazine ring, and mutual repulsion between π electrons of benzene ring and free electron pairs of the carbonyl oxygen atom causes an increase of wave numbers of the ν(C=O) band. The ν(C=O) bands of the compounds type *A* are at lower wave numbers than those of the type *B* due to formation of intramolecular hydrogen bond NH···O=C or to a greater distance between chlorine and carbonyl group. The ν(N—H) bands of the compounds type *A* are at lower wave numbers than those of the type B due to stronger hydrogen bond N—H···O=C as compared with N—H···Cl. The UV spectra of the compounds contain two to three absorption bands (in the regions 207–212, 222–253, and 293–343 nm). The shortest-wave bands are due to the $\pi \rightarrow \pi^*$ transition, the longest-wave bands are due to the $n \rightarrow \pi^*$ transition. The λ_{max} values of the longest-wave bands are affected by nature of the substituents. The compounds containing tertiary amino groups (*V*, *VI*, *XII*, *XIII*, *XIV*, *XVIII*, and *XIX*) absorb at the longest wave-

lengths (λ_{max} = 335–343 nm), which is due to distinct conjugation of the free electron pair of the nitrogen atom with π electrons of the pyridazine ring. Effect of the benzene ring bound to the nitrogen atom at 2-position of the pyridazine ring on λ_{max} is indistinct.

The prepared 5-amino (alkylamino, dialkylamino)-4-chloro-3-oxo-2-substituted--2*H*-pyridazines (*XX*–*XXXVIII*) are given in Table I and their IR and UV spectral data in Table III. The IR spectra of these compounds contain two relatively strong ν(N—H) bands in the regions of 3 302–3 329 cm^{-1} and 3 398–3 427 cm^{-1}, those at lower wave numbers being due to the vibrations of the N—H bonds involved in intramolecular hydrogen bond with chlorine and those at higher wave numbers being due to the N—H bond vibrations of free NH groups. The ν(C=O) bands are found in the region of 1 621–1 664 cm^{-1} *i.e.* at higher wave numbers than those in the spectra of the 4-amino derivatives *I*–*XIX* (Table II), which can be explained by the presence of chlorine in 4-position near the carbonyl group. In the UV spectra of compounds *XX*–*XXXVII* we can see two absorption bands in the regions of 224 to 248 nm and 280–322 nm. These compounds absorb at shorter wavelengths than compounds *I*–*XIX* which indicates lowering of conjugation of the free electron pair at the nitrogen atom of —NH— or —N— group as a consequence of effect of the chlorine at 4-position on the oxygen atom of carbonyl group. The bands corresponding to the longest-wave transition in compounds type A are found at higher wavelengths than those of the type *B*.

Nucleophilic substitution reactions of 4,5-dichloro-2-substituted-3-oxo-2*H*-pyridazines in protic organic solvent are known, but the greatest attention is paid to the reaction of 4,5-dichloro-3-oxo-2-phenyl-2*H*-pyridazine with ammonia in: *a*) methanol at enhanced pressure (about 15% of the inactive isomer 4-amino-5-chloro-3-oxo--2-phenyl-2*H*-pyridazine and about 10% of 4-chloro-5-hydroxy-3-oxo-2-phenyl--2*H*-pyridazine are formed along with the expected 5-amino-4-chloro-3-oxo-2-phenyl--2*H*-pyridazine)[2], *b*) concentrated aqueous ammonium hydroxide at enhanced pressure (the above-mentioned undesirable impurities are formed, too)[3,4], *c*) the medium of urea, formamide, and dimethylformamide at enhanced temperature (in contrast to the above cases, the amount of the 4-chloro-5-hydroxy-3-oxo-2-phenyl--2*H*-pyridazine is lower only by about 5%)[5–7], *d*) the melt of 4,5-dichloro-3-oxo--2-phenyl-2*H*-pyridazine itself at enhanced temperature (about 20% of the inactive isomer is formed along with the active isomer)[8]. Application of catalytic amounts of 4-hydroxybenzenesulphonic acid, 4-hydroxybenzoic acid, 4-hydroxyphenylacetic acid *etc.* to the amination of 4,5-dichloro-3-oxo-2-phenyl-2*H*-pyridazine in methanol at enhanced pressure results in selective substitution of the chlorine atom in the 5-position only, but also formed is 4-chloro-5-hydroxy-3-oxo-2-phenyl-2*H*-pyridazine (8%)[9]. The ratio of the isomers formed depends on the amine used and the R^3 substituent present. In none of the cases it was possible to prepare more than 56% of the *A* isomer.

TABLE III

Spectral data, fungicidal activities and IHR of synthetized compounds

No	IR, $\tilde{\nu}$, cm^{-1}			UV, λ_{max} nm log ε		TF[a]	IHR[b]
	ν(C=O)	ν(NH···Cl)	ν(NH)				
XX[c,d]	1 638	3 329	3 407[e]	224·5 4·47	280 3·80	1	0·01
XXI[d]	1 627	—	3 427	229·5 4·50	290 3·84	1	0·001
XXII	1 653	3 313	3 419	231·5 4·55	291 3·88	1	0·005
XXIII	1 640	3 310	3 410	231·5 4·45	290 3·82	2	0·05
XXIV	1 651	—	—	241 4·34	320 3·90	1	0·001
XXV	1 653	—	—	243 4·25	322 3·91	2	0·001
XXVI[f,d]	1 641	3 322	3 405[e]	230·5 4·48	287 4·10	2	1
XXVII[d]	1 629	—	3 423	236·5 4·47	300 4·07	1	0·05
XXVIII	1 664	3 302	3 408	238 4·49	301 3·11	2	0·1
XXIX	1 663	3 300	3 398	236·5 4·43	297 4·07	1	0·05
XXX	1 664	3 304	3 404	237 4·45	300 4·10	1	0·1
XXXI	1 663	—	—	247 4·30	315 4·01	1	0·5
XXXII	1 651	—	—	248 4·46	316 4·08	1	0·05
XXXIII	1 653	—	—	244 4·52	323 3·99	1	0·1
XXXIV[d]	1 629	—	3 421	240 4·43	300 4·10	1	0·1
XXXV[d]	1 621		3 425	230·5 4·52	291 4·11	1	0·001
XXXVI	1 640	3 303	3 424	230·5 4·57	290 3·96	1	0·5

TABLE III
(*Continued*)

No	IR, $\tilde{\nu}$, cm^{-1}			UV, λ_{max} nm log ε		TF[a]	IHR[b]
	ν(C=O)	ν(NH···Cl)	ν(NH)				
XXXVII	1 640	—	—	241·5 4·45	320 3·91	1	0·001
Vitavax[g]						4	

[a] Test on *Tilletia foetida*, [b] inhibition of the Hill reaction, [c] additional band $\nu_{as}(NH_2)$ 3 512 cm^{-1}, [d] measured in chloroform, [e] band $\nu_s(NH_2)$, [f] additional band $\nu_{as}(NH_2)$ 3 504 cm^{-1}; [g] standard.

At the reaction conditions chosen conversion of 4,5-dichloro-2-substituted-3-oxo--2*H*-pyridazines was complete, the starting substance being isolated in none of the experiments. In the first experiments designed to find suitable reaction conditions, non-reacted 4,5-dichloro-2-substituted-3-oxo-2*H*-pyridazine was isolated by column chromatography.

The substitution of chlorine at 4-position of pyridazine ring in aprotic solvent is not so selective as the substitution of 5-chlorine in protic solvent. The reaction conditions depend on the boiling point of the amine used: if it is below 70°C, the reaction must be carried out at enhanced pressure or the gaseous amine must be introduced into solution of the corresponding 4,5-dichloro-2-substituted-3-oxo-2*H*-pyridazine at enhanced temperature (80–120°C). Gaseous ammonia does not react at these conditions, and neither does tert. butylamine for sterical reasons (in contrast to ammonia, however, tert. butylamine does not react even in protic solvent). It was impossible to find such conditions at which the *A* isomer would be formed, and formation of 4,5-(alkyl, dialkyl)amino-2-substituted-3-oxo-2*H*-pyridazines was observed in none of the experiments and procedures. An electron-donor substitutent (—CH_3) at 2-position of the pyridazine ring (*i.e.* at nitrogen) of the 4,5-dichloro-2-substituted--3-oxo-2*H*-pyridazines makes the nucleophilic substitutions (in aprotic solvent) more favourable at 4-position than at 5-position of the pyridazine ring, so *e.g.* the *A* : *B* ratio is 2·1 for methylamine, 2·0 for isobutylamine, 1·76 for cyclohexylamine, and 2·3 for piperidine. Electron-acceptor substituent (phenyl) at 2-position of the pyridazine ring decreases the reactivity differences at the 4 : 5 position of the ring.

The compounds *I*, *VII*, *XX*, and *XXVI* were prepared in protic solvent (aqueous ammonium hydroxide) at enhanced pressure[3,4], and the isomers were separated by column chromatography. When studying the nucleophilic substitution reactions

of amines with 4,5-dichloro-2-substituted-3-oxo-2*H*-pyridazines we have found that ammonia does not react even at enhanced temperature (160°C) and pressure.

A measurable fungicidal activity *in vitro* was observed with *Tilletia foetida*, but none of the compounds tested reached the effect of the standard Vitavax. Interesting results were obtained from a model test of inhibition of the Hill reaction, where compound *XII* exhibited equal activity as the standard (pyrazone) and compound *VII* was even somewhat more effective; these two substances were submited to further tests *in vivo* at glass-house conditions. The both compounds were modified to the form of 50% wettable powders. This modification solved the problem of different solubilities and equal application. The results of tests of herbicidal activity in pre- and post-emergent application showed that in comparison with pyrazone the two compounds were only effective at the highest concentrations (5 kg ha^{-1}) in preemergent application to *Avena fatua*, *Sinapis alba*, and *Beta vulgaris*. The compounds *VII* and *XII* can only be denoted as strong inhibitors of photosynthesis at the level of isolated chloroplasts.

EXPERIMENTAL

The IR spectra were measured with an IR Specord 75 apparatus (Zeiss) calibrated by means of polystyrene film. The spectra were measured in tetrachloromethane (some of them in chloroform) in a 0·1 mm cell at the concentrations of about 10^{-2} mol dm^{-3}. The UV spectra were measured in methanol with a Unicam SP 8000 apparatus (1 cm cell; concentrations (2 to 5) . 10^{-5} mol dm^{-3}). The column chromatography was carried out on SiO_2 100/160 mesh (Lachema, Brno) using toluene with 0—10% acetone as the eluent. The silica gel was activated at 140°C for 4 h before use.

4-Amino-5-chloro-2-(methyl, phenyl)-3-oxo-2*H*-pyridazines *I*, *VII*, *XX*, and *XXVI*

A mixture of 0·1 mol 4.5-dichloro-2-(methyl, phenyl)-3-oxo-2*H*-pyridazine and 88 g 15% aqueous ammonium hydroxide was stirred in an autoclave at 130—140°C at 0·5—0·6 kPa for 7 h. The separated solid was collected by filtration, and the individual isomers were separated by column chromatography.

4-(Methyl, dimethyl)amino-5-chloro-2-(alkyl, aryl)-3oxo-2*H*-pyridazines *II*, *V*, *VIII*, *XII*, *XVI*–*XVIII*, *XXI*, *XXIV*, *XXVII*, *XXXI*, *XXXIV*, *XXXVI*

A) Methylamine or dimethylamine was added under the surface of a solution fo 0·1 mol 4,5-dichloro-2-(alkyl, aryl)-3-oxo-2*H*-pyridazine in 150 cm^3 toluene with stirring at the boiling temperature during 7 h. After cooling the mixture was washed with water, the toluene was distilled off under reduced pressure, and the isomers were separated by column chromatography.

B) A mixture of 0·07 mol 4,5-dichloro-2-(alkyl, aryl)-3-oxo-2*H*-pyridazine and 60 cm^3 toluene was treated with 0·16 mol methyl- or dimethylamine. The mixture was stirred at 130 to 140°C at 0·2—0·3 kPa for 7 h. The further procedure was the same as above.

4-Butyl(cyclohexyl, pyrrolidine, piperidine, 2-methoxyethyl)-amino-5-chloro-2-(alkyl, aryl)-3-oxo-2*H*-pyridazines *III*, *IV*, *VI*, *IX*—*XI*, *XIII*, *XIV*, *XVII*, *XIX*, *XXII*, *XXIII*, *XXV*, *XXVIII* to *XXX*, *XXXII*, *XXXIII*, and *XXXVII*

0·21 mol amine was added at once to a solution of 0·1 mol 4,5-dichloro-2-(alkyl, aryl)-3-oxo--2*H*-pyridazine in 150 cm^3 toluene, and the mixture was stirred and boiled for about 7 h. Thereafter the mixture was washed with water, toluene was removed by vacuum distillation, and the residue was separated by column chromatography to obtain the two isomers.

Biological Tests

The fungicidal activity was investigated by the *in vitro* methods using the fungi *Tilletia foetida*, *Botrytis cinerea*, *Fusarium avenaceum*, and *Alternaria alternata* according to ref.[10]. Vitavax, Euparen, Kaptan, and Metylénrodanid were used as the standards. The model test of inhibition of the Hill reaction was carried out by the described[11] *in vitro* method using pyrazone as the standard. Herbicidal activity on living plants was determined by the published procedure[12].

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