gonadotropins. Adler (*13*) in a similar manner has demonstrated a relation between the number of intromissions and the probability of pseudopregnancy, and he, as well as Chester and Zucker (*14*), have shown that copulatory behavior is related to sperm transport and pseudopregnancy in the rat. These authors call attention to the need for comparative data. Studies of the hamster further indicate that release of progestin initiated by particular mating stimuli may be involved (*15*).

The concept is thus established that species-related neural stimuli from the vagina, integrated with other sensory inputs accompanying mating, are crucial for the initiation of neural and endocrine mechanisms supporting pregnancy and pseudopregnancy.

Note added in proof: Since preparation of this manuscript, McGill and Coughlin have suggested that the penile swelling of the ejaculating male leads to mechanical stretching of the vagina or cervix (or both) and that this is the stimulus which induces luteotropin release in the mouse (*16*).

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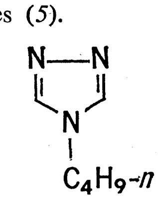
Wheat Leaf Rust: Control by 4-n-Butyl-1,2,4-triazole, a Systemic Fungicide

Abstract. *Compound 4-*n*-butyl-1,2,4-triazole was demonstrated as an enduring and selective systemic fungicide for the control of wheat leaf rust by foliar and soil applications. Among several species of rust fungi treated, only wheat leaf rust* (Puccinia recondita *Rob.*) *was controlled. Wheat stem rust, for example, was unaffected by either soil or foliar applications.*

The leaf rust disease of wheat incited by *Puccinia recondita* Rob. is apparent each year in the central and southern wheat-growing areas of the United States. The intensity of the infection is variable; however, a survey conducted over a 33-year period in Illinois concluded that leaf rust was the most damaging wheat disease in that region (*1*).

Chemical control practices for cereal rusts have been reviewed by Rowell (*2*). Chemical control of leaf rust has resulted in yield increases (*3*); however, maximum yield increases have been the result of multiple spray applications of protectant fungicides which act on the surface of the plant. An ideal method of controlling leaf rust would be the single application of an enduring systemic fungicide.

Several members of a series of 4-substituted 1,2,4-triazoles have shown enduring activity as fungicides by root uptake and as foliar sprays for control of wheat leaf rust. Superior performance has been noted for 4-*n*-butyl-1,2,4-triazole which has been extensively field tested under the code designation RH-124. The synthesis of 4-substituted 1,2,4-triazoles has been reviewed (*4*), and a recently described procedure may be utilized in preparing 4-substituted 1,2,4-triazoles (*5*).



4-*n*-Butyl-1,2,4-triazole

Soil incorporation of 4-*n*-butyl-1,2,4-triazole revealed a high degree of systemic fungicidal activity as a result of root uptake. Equal weights of clay-loam soil were spray treated in a rotary mixer to give 5.0 and 1.0 part per million of 4-*n*-butyl-1,2,4-triazole and of 2,3-dihydro-5-carboxanilido-6-methyl-1,4-oxathiin-4,4-dioxide; the latter compound was used as a standard treatment (*6*). The treated lots of soil were subdivided into two portions; one portion was seeded immediately after treatment with Pennoll wheat, and the second was kept moist and held for 12 days prior to planting. Inoculations were made by spraying a suspension of urediospores onto the wheat seedlings 7 days after each planting. Percentage of disease control was determined 14 days after each planting by counting lesions on ten seedlings in each of three replicates per dosage.

Under these conditions, 4-*n*-butyl-1,2,4-triazole provided complete control of wheat leaf rust at 5.0 and 1.0 ppm, regardless of planting time. The standard treatment gave 40 and 0 percent control at 5.0 and 1.0 ppm, re-

Table 1. Control of leaf rust of Pennoll wheat in laboratory and field tests by foliar application of 4-*n*-butyl-1,2,4-triazole. Field treatment was made at 372.8 liters of carrier per hectare to four plots of 1.5 by 1.6 m at the two-leaf stage. Inoculum was applied in the field 3 and 10 days after treatment as urediospores in talc. Control was determined by lesion counts on 25 plants per plot 35 days after treatment. Laboratory treatments were applied in a mixture of acetone and water (1 : 1). Inoculation was done in the laboratory test 7 days after treatment, and disease readings were made 15 days after treatment on the new growth. The standard treatment was 2,3-dihydro-5-carboxanilido-6-methyl-1,4-oxathiin-4,4-dioxide.

Treatment	Percentage control			
	Dosage (kg/ha)			
	0.14	0.28	0.56	1.12
4-n-butyl-1,2,4-triazole				
Laboratory	88	97	100	100
Field			100	100
Standard				
Laboratory	76	78	92	96
Field			0	9

Table 2. Summary of the spectrum of fungicidal activity of 4-*n*-butyl-1,2,4-triazole. Minus indicates not active; plus, active; and zero, not tested.

Pathogen	Host	Root uptake (10 ppm at planting)	Foliar spray (1200 ppm)
Uromyces phaseoli	Bean	—	—
Puccinia coronata	Oats	—	—
Puccinia recondita	Wheat	+	+
Puccinia graminis	Wheat	—	—
Puccinia hordei	Barley	—	0

spectively, in the initial planting and no control in the delayed planting.

Applications of 4-*n*-butyl-1,2,4-triazole to wheat foliage also provided a high degree of leaf rust control in both laboratory and field experiments (Table 1). By growing the treated plants for 7 days prior to infection and then noting disease control on the new growth, the systemic fungicidal activity was demonstrated. The activity provided by foliar applications was more apparent under field conditions where a severe epidemic developed in untreated plots as a result of continuous infections (Table 1).

A narrow spectrum of fungicidal action by bioassays in vivo was noted. In fact, possibly the most selective fungicidal effect known among systemic fungicides was exhibited by 4-*n*-butyl-1,2,4-triazole, since among several rusts studied only wheat leaf rust was controlled. In foliar spray tests which lacked weathering as a factor determining activity, bean rust, crown rust of oats, and wheat stem rust were not affected by concentrations of 1200 ppm (Table 2). Similar results were noted in root uptake experiments at 10 ppm. The possibility of fungicidal selectivity due to lack of translocation was excluded by the negative result on wheat stem rust since the same wheat variety, Pennoll, was used to demonstrate leaf rust control.

Compound 4-*n*-butyl-1,2,4-triazole has thus appeared unique in two respects. Complete disease control at 0.56 kg/ha for a period exceeding 30 days demonstrated a degree of control of wheat leaf rust previously unknown. The spectrum of control within the genus *Puccinia* was limited to wheat leaf rust, thus making 4-*n*-butyl-1,2,4-triazole a remarkably selective fungicide.

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Catalytic Activities of Thermally Prepared Poly-α-Amino Acids: Effect of Aging

Abstract. *Thermally prepared poly-α-amino acids were tested after being stored in the dry state for 5 to 10 years. Polymers effective in catalyzing the hydrolysis of* p-*nitrophenyl acetate showed the same levels of activity as observed 10 years earlier. Polymers effective in catalyzing the decarboxylation of oxaloacetic acid had in 5 years become insoluble in assay medium; their activity, however, had increased by 32 to 145 percent. The results suggest that particular primitive enzyme molecules could have been stable enough to have contributed to evolutionary processes long after they had been produced.*

A model for prebiotic protein, as developed in recent years (*1*), provides an experimental basis for theoretical concepts (*2*) concerning the origin of life. Polyamino acids are formed by the simple heating together of proper proportions of dry amino acids under postulated geological conditions. The resulting polymers can range in complexity from homopolymers or few-component polymers to polymers that contain some proportion of each of the 18 common proteinogenous amino acids (proteinoids). The latter resemble present-day protein in many of their properties (see *1*).

Catalytic activity is one property of thermally prepared polyamino acids that has been investigated in considerable detail, as recently reviewed (*3*). These polymers accelerate the chemical conversion of at least 15 different substrates in four major kinds of reactions. These are hydrolyses, decarboxylations (including photo-promoted ones), aminations, and deaminations. Although generally weak in comparison to that of contemporary enzymes, the activity of the thermal polymers is in all cases greater than that of the equivalent amount of unpolymerized amino acids, which in some cases is measured as zero. Differential action, as would be necessary for metabolism (*3*), has also been shown. These and other findings have been interpreted in a context of abiotic origins of enzymes and metabolism (*3*).

The long-term stability of the catalytic properties of thermal polyamino acids is of interest, since they are regarded as models for primitive enzymes (*3*). Conceptually, a primitive catalyst would need to be stable for relatively long periods of time if it were to be available over a long period to contribute to processes of molecular evolution. An approach was made in this study toward estimating the stability of prebiotic enzymes, by retesting the thermal polymers (in the capacity of model compounds) first shown to be catalytically active 5 to 10 years ago.

The catalyzed reactions studied were

Table 1. Activities on *p*-nitrophenyl acetate before and after heating buffered solutions of thermal polyamino acids. The polymers were prepared and first assayed during the period 1960–63 (*4–6*). Assays were at *p*H 6.8, as described in the text; average of six determinations (five for polymer 0-2.8, heated) in the current study. See (*6*) for the meaning of the polymer code.

Polymer	Current: Activity ± S.D.* (10^{-2} μmole min^{-1} g^{-1}) Unheated	Current: Heated	Current: Inactivation† (%)	Previous: Activity (10^{-2} μmole min^{-1} g^{-1}) Unheated	Previous: Heated	Previous: Inactivation† (%)
			Proteinoids			
E-1.3	98 ± 6	9 ± 8	91	60	5	91
I-2.8-b	60 ± 6	23 ± 5	62	70	22	69
K-2.8-b	34 ± 9	17 ± 3	50	39	12	69
E-8.0	125 ± 8	67 ± 7	46	88	70	20
B-8.0	85 ± 16	48 ± 6	44	72	42	40
B-13.5	169 ± 12	109 ± 8	36	110	98	11
K-3.4	62 ± 13	41 ± 3	34	54	34	37
			Copolymers of aspartic acid and histidine			
0-2.8	50 ± 11	31 ± 5	38	48	18	62
0-12.3	214 ± 15	159 ± 8	26	232	173	25

* Standard deviation (*12*). † Percentage of inactivation is $\left[1 - \frac{\text{activity (heated)}}{\text{activity (unheated)}}\right] \times 100.$