after 11 days incubation was 235, 130, and 63, respectively. Only a few eggs were found within the host plants grown at 2 percent oxygen.

The large reduction in number of galls at the lower oxygen levels appears to be due to the reduced hatching rate and development of the eggs of the original females and the reduction in infectivity of the larvae in the soil. The possibility that soil aeration affects nematodes has long been recognized; however, it has been difficult to establish direct evidence that inadequate oxygen in the soil limits the activity of nematodes except under rather extreme conditions. These results indicate that the activity of some nematodes in the soil phase is more dependent upon the availability of oxygen than previously thought.

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References

1. H. R. Wallace, *Ann. Appl. Biol.* **44**, 57 (1956).
2. L. H. Stolzy, S. D. Van Gundy, J. Letey, Jr., *Phytopathology* **50**, 656 (1960).
3. C. Overgaard Nielson, *Natura Jutlandica* **2**, 1 (1949); R. A. Rohde, *Proc. Helminthol. Soc. Wash., D.C.* **27**, 160 (1960); P. H. Santmyer, *ibid.* **23**, 30 (1956).
4. L. H. Stolzy, O. C. Taylor, J. Letey, Jr., T. E. Szuszkiewicz, *Soil Sci.* **91**, 3 (1961).
5. A. F. Bird, *Nematologica* **4**, 31 (1959).
6. J. Letey, Jr., O. R. Lunt, L. H. Stolzy, T. E. Szuszkiewicz, *Soil Sci. Soc. Am. Proc.* **25**, 183 (1961).

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Simultaneous Appearance of Free Arginine and Deoxyribosidic Compounds during Mitosis

Abstract. Sequential measurements were made of the free amino-acid pool in the premitotic region of microspores of *Lilium longiflorum*. The basic amino acid arginine appears in the pool and then disappears. Arginine appears at the same developmental stage at which it has been reported that the free deoxynucleosides appear.

The mitotic division in the microspores of *Lilium longiflorum* presents a particularly favorable subject for the study of the chemistry of mitosis. It is especially favorable for two reasons. First, a morphological index of development (*1*) orders the sequence of events during the interphase preceding mitosis; second, the microspores undergo this mitosis in synchrony (*1*). Using this material, Foster and Stern (*2*) and Taylor (*3*) have been able to show the precise time, during the interphase preceding mitosis, at which deoxyribonucleic acid (DNA) is synthesized. Nasatir, Bryan, and Rodenberg (*4*) showed changes in the composition of the soluble proteins during interphase and mitosis. The large quantitative change in the free deoxyribosidic compounds (*2*) and the correlation of this peak value with the doubling of one of the soluble proteins (*4*) led us to an examination of the associated changes in the free amino acids.

Table 1. Change in concentration of the free amino acids in the anther, with respect to the length of the flower bud in *Lilium longiflorum*. Mitosis of the microspores occurs at 60 mm.

Bud length (mm)	Change in concentration (μmole/anther)		
	Lysine	Histidine	Arginine
50	4.67	0.32	
52.5	1.25	5.10	2.25
54	2.40	0.31	
55	1.62	2.10	
60	3.40	7.30	

Flower buds of *Lilium longiflorum* Thunb. cv. "Croft" of varying lengths were removed, and the anthers were excised. The anthers were homogenized in 70-percent ethanol and centrifuged. The supernatant fraction was evaporated and the residue was dissolved in 2.5 ml of *p*H 2.2 buffer. The amino acids were separated by column chromatography by the methods of Moore and Stein (*5*). The quantity of each amino acid was determined by the ninhydrin reaction described by Moore and Stein (*6*).

Changes in many amino acids were found, but the most striking were the changes of the basic amino acids, lysine, histidine, and arginine. A measurable amount of arginine was present only at a bud length of 52.2 mm. This is the same bud length at which Foster and Stern (*2*) found free deoxyribosidic compounds and at which Nasatir, Bryan and Rodenberg (*4*) found the doubling of one of the soluble proteins. Histidine and lysine, in contrast to arginine, were present at all the bud lengths measured: 50, 52.5, 54, 55, and 60 mm. At the time of DNA synthesis, arginine appeared and histidine increased over tenfold, but lysine decreased by a factor of four. Later, at the time of mitosis, arginine was absent, but the concentrations of both lysine and histidine tripled. These results are summarized in Table 1.

Because of the small number of buds analyzed, it is difficult to say definitely how the pattern of the free amino-acid pool changes with development. For example, it is not possible to decide whether the high level of arginine is present during all the premitotic fluctuations in free deoxyribosides or whether the concentration follows these fluctuations in detail. If the concentration fluctuates, there may be more than one peak. To demonstrate such a second peak would require the use of a much larger number of buds.

On one point, however, the data are quite unambiguous: Two amino acids, distinctively present in chromosomal protein, undergo marked concentration changes close to the time of DNA doubling. This result leads us to speculate that the pertinent protein synthetic mechanisms undergo a corresponding change related to the requirements of chromosome duplication.

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References and Notes

1. R. O. Erickson, *A. J. Botany* **35**, 729 (1948).
2. T. S. Foster and H. Stern, *Science* **128**, 653 (1958); *J. Biophys. Biochem. Cytol.* **5**, 187 (1959).
3. J. H. Taylor, *Exptl. Cell Research* **4**, 164 (1953).
4. M. Nasatir, A. M. Bryan, S. D. Rodenberg, *Science* **132**, 897 (1960).
5. S. Moore and W. Stein, *Anal. Chem.* **30**, 1185 (1958).
6. ———, *J. Biol. Chem.* **211**, 907 (1954).
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Virus–Tumor Synergism

Abstract. More than 30 mouse tumors are associated with virus-like agents that may readily be detected by enzymic techniques. Radiation and chemically induced tumors do not ordinarily give evidence of such activity. The present report is of experiments in which a synergistic effect has been observed to occur when animals were inoculated with both the filtrable agent and a virus-free tumor. Synergism was shown by accelerated growth of the tumor and by elevation of a glycolytic enzyme (lactic dehydrogenase) in the host plasma.

Most transplantable mouse tumors and their hosts have been shown recently to have a virus-like agent, or agents, associated with them (*1, 2*). While these tumor-host-virus associations now include over 30 varieties of tumor types as revealed by enzymic techniques, the relationship of these agents to the neoplastic process is still uncertain (*2*).