

A Short Summary on our Botanical Knowledge of *Lolium Temulentum* L.

By DR. A. C. LEEMANN, Division of Plant Industry, Pretoria.

Common names : Afrikaans : Drabok :

English : Darnel, Ivray, Poison Ray Grass ;

French : Ivraie (ivrc=drunken) ;

German : Taumellohch (Taumel=giddiness).

Primitive people know their botany well and by some cruel experience were led to distinguish between poisonous and non-poisonous plants. It is therefore in no way astonishing that the toxicity of darnel was well known to the ancients.

The oldest quotation is perhaps that of the Bible, where the description in St. Matthew 13, 25-30, leaves practically no doubt that the darnel was being referred to. It is worth while quoting those lines in full.

“ But while men slept, his enemy came and sowed tares among the wheat, and went his way.

“ But when the blade was sprung up, and brought forth fruit, then appeared the tares also.

“ So the servants of the householder came and said unto him, ‘ Sir, didst not thou sow good seed in thy field ? From whence then has it tares ? ’

“ He said unto them, ‘ An enemy hath done this.’ ‘ Wilt thou then that we go and gather them up ? ’

“ But he said, ‘ Nay ; lest while ye gather up the tares, ye root up also the wheat with them.’

“ ‘ Let both grow together until the harvest : and in the time of harvest I will say to the reapers, Gather ye together first the tares, and bind them in bundles to burn them : but gather the wheat into my barn.’ ”

This can only refer to the darnel. It is as the householder says hardly distinguishable from wheat in the young stage and it is therefore wise to wait until it is full grown before it is eradicated. The best way of eradicating it is by fire. The above text shows quite clearly how dreaded the weed was : well known to be used as an offence, well known also the time and way to discard it.

In several publications the following quotations from ancient writings are mentioned :—

The name *Lolium* is mentioned in Vergil and Dioscorides, and seems to derive, according to Guyot, from le celtic *Loloa*.

Ovid says : “ Let the field be clear of darnel that weakens the eyes.”

In Plautus’ comedy the “ Braggart Soldier ” one servant says to another : “ ’Tis a wonder that you are in a habit of feeding on darnel with wheat at so low a price.” “ Why so.” “ Because you are so dim of sight.”

Then Shakespeare says :—

“ Want ye corn for bread ?

I think the Duke of Burgundy will fast

Before he’ll buy again at such a rate.

’Twas full of darnel : Do you like the taste ? ”

Henry VI : Act III, Sc. 2.

Then *Gerarde* in 1597, says:—

“The bread wherein Darnell is, eaten hot causeth drunkenness; in like manner doth beer or ale where the seed is fallen, or put into the malt.”

Sinclair in 1869 holds that “neither birds nor beasts choose this detested food. It is excessively bitter and if ground with wheat into flour and made into bread it renders it not only unpalatable and unwholesome but actually poisonous. But it has from earliest ages borne the name of ‘drunken darnel’ and there can be no doubt of its deleterious qualities whether in meat or in drink.”

Sinclair goes on saying, and his statements remind of the lines quoted from scripture.

“We have often been plagued with darnel: and the only means we used was enjoining a duty upon the reapers, binders and barn men, to collect it in small bundles for the fire, for which a small reward was given. Its early growth is so much like the wheat plants, that it cannot be weeded out by spud as other weeds are, of course it stands till reaped with the wheat.”

Lolium temulentum L. is a native plant of Europe. It is a pest in its native country and has become a pest all over the world. It must have been carried to foreign countries at the same time as wheat. We have attached a photograph of the plant, the specimen being No. 822 of the National Herbarium at Pretoria.

Toxicity is rare in grasses. The toxicity of *Lolium* cannot be put down with safety to the plant itself.

In the case of *Lolium* three possibilities must be considered:—

1. Toxicity of plant and grain in themselves.
2. Toxicity of the fungus invading grain and plant.
3. Toxicity from interaction of the plant and the fungus.

We shall endeavour first to consider the question whether the plant in itself is toxic. The plant being a grass there is not much likelihood that it would be so.

Long says: “Before the seeding stage is reached Darnel seems to be quite suitable as food for stock, only the seed or grain being poisonous and this not invariably so.” According to some careful investigation by Nestler the fungus can easily be detected in the whole plant from its earliest germination to the adult stage. It seems thus that the plant in itself is not toxic and that we may safely assume that toxicity is only in the seeds.

To ascertain whether the seed in itself is toxic we should attempt to obtain fungus free seeds. Freeman says that in nature there are two races of *Lolium temulentum*, the one is fungus infected and the other is fungus free. He thinks that there is no transference of the fungus from the one to the other. Freeman has, however, failed to prove his statements conclusively, so that they still remain interesting suggestions. From a quotation in Czapek I gather that Hannig has succeeded in producing the two above mentioned races artificially and that the fungus free plants were not toxic. If this experiment is confirmed it would be the ultimate demonstration that the plant in itself is not toxic. It would still remain to be shown that the fungus in itself is toxic, or that the interaction between fungus and plant creates the toxin.

An experimental method that could be followed, although laborious would be the following. To cut seeds in half, to examine one half for the presence of the fungus and to feed the other half. This method would allow with a high degree of probability to test the effect of non-infected material.

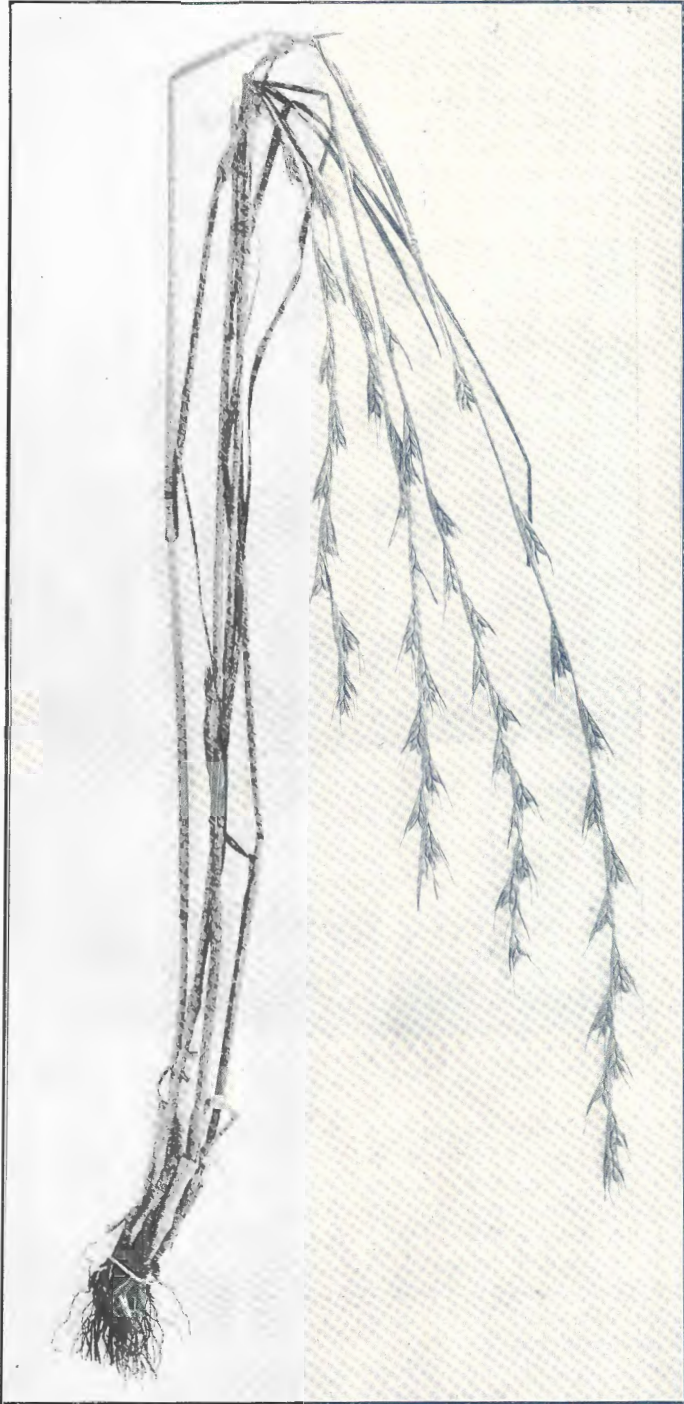


FIG. 1.—*Lolium temulentum* L., National Herbarium 8228. Photo by H. King.

A disturbing factor enters however from the fact that the toxicity seems to be variable. It is reported that in wet seasons the toxicity is more pronounced than in dry seasons. How far that statement is justified I cannot tell. It is well known also that the experiments even during the same season are erratic. A variability of toxicity is quite possible; unfortunately it complicates the whole problem and makes many conclusions uncertain.

We could here refer to the argument put forward by Guerin which although not quite conclusive may yet serve as a useful hint.



FIG. 2.—*Lolium temulentum*, Mycelium of Fungus above the Aleurone Layer. Photo by A. C. Leemann.

Guerin says: "In forty seeds of most diverse origin the mycelial zone is lacking from but three. This observation had been confirmed in other species of *Lolium* to wit *L. perenne* L., *L. arvense* With. (var *L. temulentum*), *L. vivicola* Sond. It is only exceptional that the first of these contains the parasite. The rest are infected to the same degree as *L. temulentum*. When one observes that the species reported poisonous are the very ones in which we have found the parasite, it seems reasonable to ask whether the temulin of Hofmeister is not a result of the action of the fungus upon the nitrogenous materials in the peripheral region of the seed."

Considering now the fungus infecting the plant, we must admit that we know but little of it. It does not always infect the plant, some of the specimens are absolutely free of fungus.

Vogl seems to be the first who drew attention to the presence of the fungus in the seeds of *Lolium temulentum*. Hanausek, Nestler and Guerin then made a study of it. Guerin states that the nucellus of the ovum is filled with hyphae. With the development of the endosperm the original nucellus is reduced to a small layer at the periphery and the fungus is so to say crowded out. In mature seed the fungus only occurs in the hyaline layer outside the aleurone layer as can be seen from our photomicrograph.

Guyot mentions the interesting fact that G. Lindau in 1904 has detected the fungus in darnel seeds coming from the tombs of one of the Pharaohs of the dynasty (2400 B.C.). Nestler has made an extensive study of the fate of the fungus during and after germination. He has detected the fungus right along the stem and followed its path into the seeds. No fructification bodies of the fungus have as yet been found.

Endocamidium temulentum Prill. and Del. has often been considered as the possible parasite. Guerin most emphatically denies that. I feel inclined to follow the idea of Guyot who believes that the above fungus is parasitic on rye and symbiotic in *Lolium*. The infected rye produces symptoms of intoxication which are very much similar to those in darnel. The suggestion of Guyot should therefore retain our attention. Rye may possibly be a second host to the fungus, a host where it fructifies.

The absence of fructification in the fungus renders determination practically impossible. Nobody has as yet succeeded in making an artificial culture of the fungus. I have also made an attempt on a medium consisting of agar plus ground darnel seeds. But so far nothing but well known saprophytes could be detected in the plates. Nestler has tried a series of other media without result.

The presence of the fungus does not impair germination. This speaks in favour of Guyot's idea of Symbiosis. The infected seeds show an excellent germination. This of course could be brought in parallel with the cases of mycorrhiza where the presence of the fungus is helpful to the metabolism of the plant.

The fungus infecting the darnel has sometimes been considered to be a smut. Although it behaves to a certain extent just like a smut, there is however no definite proof for that supposition. It is therefore best to leave the question entirely open until further evidence permits to decide.

The plant is a nuisance and should be eradicated. It should be picked and burnt *before* its seeds reach maturity.

BIBLIOGRAPHY.

- ANTZE, P. (1891). *Arch. f. exp. Path. u. Pharm.*, Vol. 28, p. 126.
 CORNEVIN, Ch. (1887). *Les Plantes vénéneuses*.
 CZAPEK, F. (1921). *Biochemie der Pflanzen.*, Vol. 3, p. 247.
 ESSER, F. (1910). *Die Giftpflanzen Deutschlands*.
 FREEMAN (1902). *Proc. Roy. Soc.*, Vol 71, p. 27.
 FYLES, FAITH (1920). "Principal Poisonous Plants of Canada" (Dept. of Agric.).
 GEORGIA, ADA E. *A Manual of Weeds*.
 GUERIN, P. (1899). "The probable causes of the poisonous effects of the Darnel" (*Lolium temulentum*), *Bot. Gazette*, Vol. 28, p. 136.
 GUYOT (1928). *Ivraie enivrante et seigle enivrant.*" *La Nature*, 2781, p. 263.

- HANNIG, E. (1907). *Bot. Ztg.*, Vol. 65, p. 25.
- HANAUSEK, T. F. (1898). "Vorläufige Mitteilung über den von A. Vogl in der Frucht von *Lolium temulentum* L. entdeckten Pilz.", *Ber. d. deutsch. bot. Ges.*, Vol. 16, p. 263.
- HENRY, T. A. (1913). "The plants Alcoloids."
- HENSLOW, REV. G. (1901). "Poisonous Plants in Field and Garden."
- HOFMEISTER, F. (1892). *Arch. f. exp. Path. u. Pharm.*, Vol. 30, p. 203.
- JOHNSON, C. P., & SOWERBY, T. E. (1861). *The British Poisonous Plants.*
- KOBERT, R. (1906). *Lehrbuch der Intoxicationen*, Vol. 11, No. 2, pp. 1009, 1013.
- LONG, HAROLD C. (1917). *Plants poisonous to live stock*, Cambridge Agric. Monogr., No. 82-84.
- MEDLEY WOOD, J. (1905). *Natal Plants*, Vol. 5, Plate 463.
- MULLER, G. "Landwirtschaftliche Giftlehre."
- NESTLER, A. (1898). "Ueber einen in der Frucht von *Lolium temulentum* L. vorkommenden Pilz.", *Ber. d. deutsch. bot. Ges.*, Vol. 16, p. 207.
- PAMMEL, L. H. *Manual of Poisonous Plants.*
- PARKINSON, S. T., & RUSSELL, E. J. (1907). "A list of plants poisonous to stock," *Jnl. S.E. Agr. Coll.*, Wye, Kent, No. 16.
- POTT, EMIL (1907). "Handbuch der tierischen Ernährung und Landwirtsch Futtermittel," II Bd.
- SALISBURY, F. S. (1914). "A list of Grahamstown Weeds," *Agr. Jnl. of S.A.*, Vol. 7, pp. 77-82.
- SINCLAIR, G. (1869). *The Weeds of Agriculture.*
- SMITH, A. BERNARD (1904). *Poisonous plants of all countries*, p. 6.
- SORAUER, P. (1932). *Handbuch der Pflanzen Krankheiten*, Bd. 3, 2 Teil, p. 729.
- STEYN, D. G. (1929). *15th Rept. Dir. Vety. Serr.*, Union of S.A., Part 2, p. 793.
- STRASSBURGER, E., NOLL, F., SCHENCH, H., & KARSTEN, G. *A Text-book of Botany.*
- TSCHIRCH, A. (1923). *Handbuch der Pharmakognosie*, Vol. 3, p. 140.
- UNITED STATES DISPENSARY. 20th Ed., p. 1474.
- VEFERJANIAN, 1842.
- VOGL, A. E. (1898). *Zeitsch. f. Nahrungsmittel Untersuch.*, etc., Vol. 12, No. 2, p. 28.
- WALSH, J. H. (1909). *South Afr. Poisonous Plants*, p. 24-25.
- WATT, J. M., & BREYER-BRANDWYK, M. G. *The Medicinal and Poisonous Plants of Southern Africa.*
- WILLMOT, F. C., & SILBERBAUER, S. F. (1931). *Jnl. Med. Ass. S.A.*, Vol. 5, pp. 370-381.