

examined not only clinically but also hæmatologically before each donation of blood; that the amount of blood to be donated by any donor should be judged from the weight, blood pressure and blood values of the donor; that generally not more than 300 c.cm. of blood should be taken out at one time from any Bengali donor; that the interval between two successive donations should never be less than 3 months in the case of male donors and 4 months in the case of female donors; and that the donor should be advised to take adequate animal protein, at least for 2 to 3 weeks after each donation of blood.

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POISONOUS FOODGRAIN: WHEAT MIXED WITH *LOLIUM* *TEMULENTUM*

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AN EPIDEMIC IN ADEN

IN the March issue of this journal there appeared under 'Medical News' (p. 148; an abstract from an article by Brinton) an account of an epidemic at Aden caused by the seed of *Lolium temulentum*, a weed which grows in wheat fields. The wheat was brought from Abyssinia and milled locally by machinery. The consumption of the product made the inhabitants go down with symptoms of acute intoxication. For 13 months from October 1942 the population suffered intermittently. Some 450 persons suffered. From $\frac{1}{4}$ hour to 2 hours after taking

food made from this grain a man became dizzy and developed headache, generalized tremors, lassitude, slurred speech and staggering gait. Nausea, abdominal pain, vomiting and diarrhoea were also in evidence at times. Those who had fed well became stuporous or even comatose for as long as 10 hours while those who had eaten only a little recovered in 3 to 4 hours. There were no deaths. All were well enough to resume their usual occupation in 72 hours.

The weed is said to be known to the farmers in Arabia as *Miscara* and is removed before the wheat is ready for reaping. This precaution was not taken in Abyssinia. The wheat mixed with the weed seed is sieved in Abyssinia and the seed removed before milling. This precaution was not taken in Aden. Ordinarily, in Asia, the housewife hand-winnows the wheat before milling and thus removes all grains other than wheat. This step was missed in Aden. Later, in the samples taken for examination, the weed seeds were found to be up to 10 per cent.

THE WEED

Historical.—The harmful nature of the grains of *L. temulentum* has been known for centuries and it possibly represents the 'tares' of the Scriptures. As early as 1789 it was stated that the seeds possess very intoxicating quality and bring on convulsions if taken in large quantities (Adam, quoted by Brenchley, 1920). The weed is known to Indian toxicologists (Owens, 1935; Modi, 1943). The plant is known in different countries by different popular and local names. The popular English name for it is 'darnel' or 'bearded wheat'. One of the many other local English names is the 'drunken plant' which proves the knowledge of the people about its effect on man (Brenchley, *loc. cit.*). The Arabian name *Miscara* which means tipsy describes its effect on man. In France darnel is called *Ivræ* and in Germany *Taumelloch*. In the Punjab and North-West Frontier Province of India the local names for it are *Mostaki* and *Mochni* respectively.

Distribution.—The plant is distributed throughout Europe and Northern Asia (*Index Kewensis*); in other places it has been introduced. It was reported from Argentina (Marchionatto, 1941) that the plant is a wild grass there and that the toxic nature of the seeds to man and animals is known to local people. In India it is found in the Upper Gangetic Plain, the Punjab, Sind and Western Himalayas, from 4 to 6,000 feet, and is an introduced plant in the Kashmir State (Hooker, 1897). It was introduced into Shillong, Assam, in the year 1934 (Bor, 1940). The plant is not reported from Bengal, Bihar, Orissa, Madras and Bombay (Prain, 1903; Haines, 1925, Gamble, 1928; Blatter and McCann, 1935). From the nature of distribution of the plant it appears that the darnel mixed with wheat grain, which produced the epidemic in Aden, was imported into Abyssinia from abroad.

* Not seen in original.

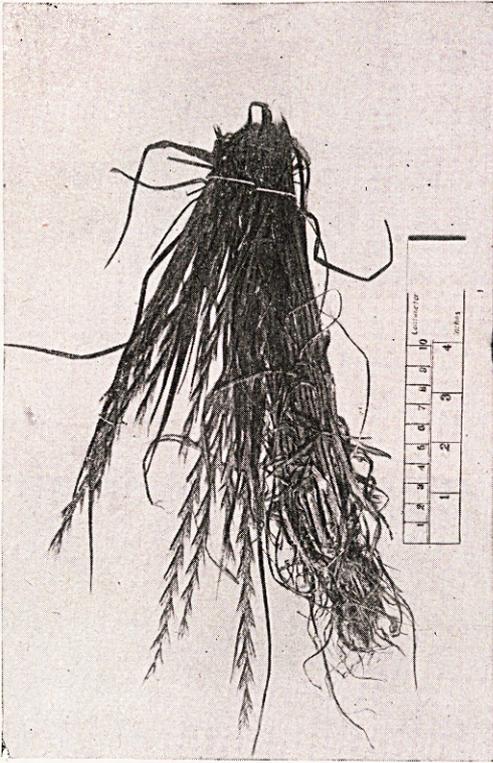


Fig. 1.—Showing *Lolium temulentum*. Many tillers together. Note lax spikelets in the ear.

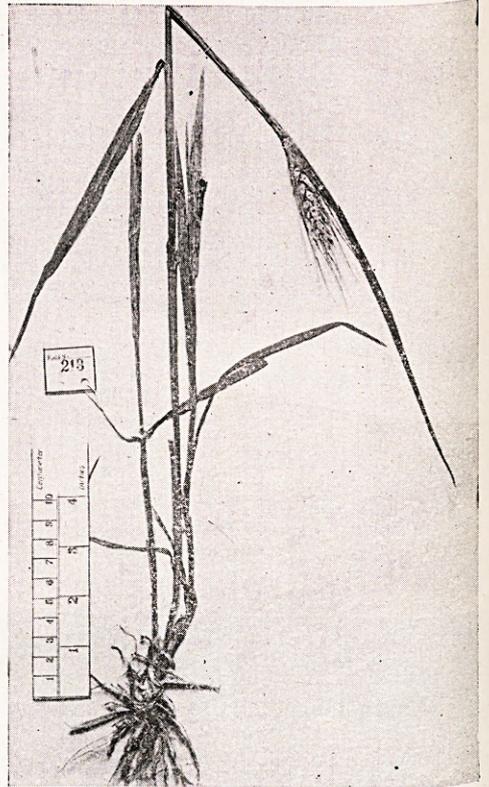


Fig. 2.—Showing *Triticum vulgare*. Only three tillers shown. Note compressed spikelets in the ear.

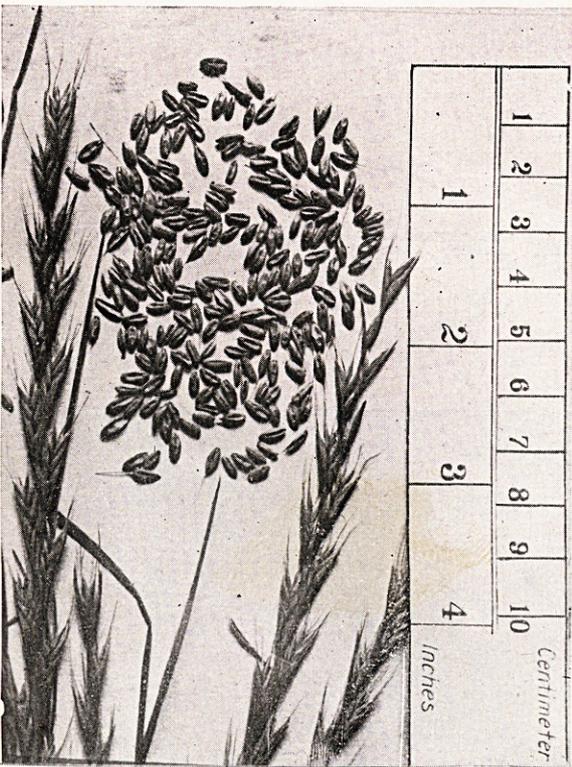


Fig. 3.—Showing grains of *L. temulentum*. Note a close resemblance to wheat in shape (not in size).

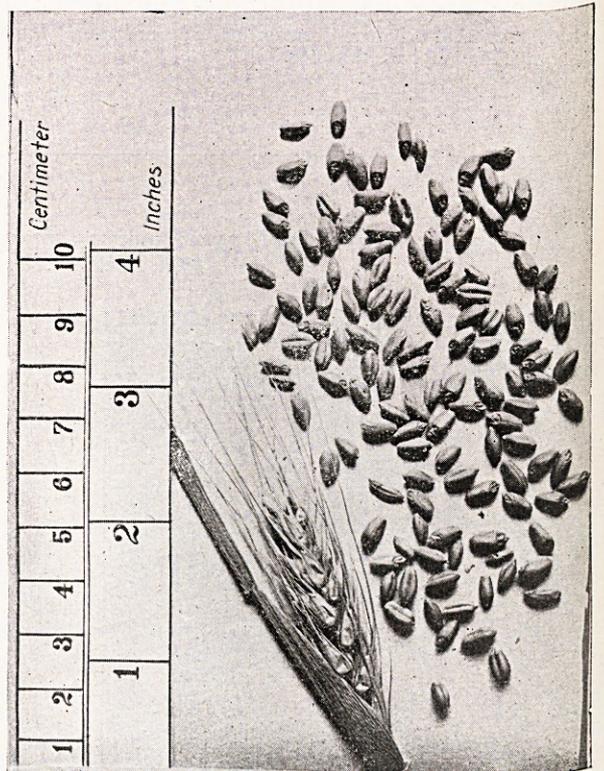


Fig. 4.—Showing wheat grains.

(For 'centimeter' read 'centimeters'.)

It is interesting to note that unlike *L. temulentum* other species of *Lolium* are well known as fodder and pasture grasses, e.g. English rye-grass (*L. perenne*), Italian rye-grass (*L. multiflorum*) and annual rye-grass (*L. remotum*).

THE FUNGUS

It is now well established that the poisonous nature of *L. temulentum* grains is due to the harbouring of an endophytic fungus between the seed coat and the endosperm. The fungus lives symbiotically in the grains and is carried from one generation to the next through the germinating seedling to the developing ovary and finally to the mature grains. Grains of *L. temulentum* nearly always harbour the fungus and it is claimed that the harbouring plants are richer in nitrogen than the non-harbouring ones (Engler and Diels, 1936). Fresh lodgement occurs during spike formation (Marchionatto, 1941). On examination of seed samples in Argentina it was found that the fungus was present in 75 per cent of the grains of *L. temulentum*, 25 per cent of the grains of *L. multiflorum* and absent in the grains of *L. perenne*. The germinating capacity of non-harbouring seeds was however greater than that of the harbouring ones.

Attempts to isolate the darnel fungus were made in 1903 and 1906 (Freeman, 1903; 1906) and it was suggested that the fungus was related to the Ustilaginæ (smut fungi). Later, the endophytic fungus from wheat, barley and rye-grass (*L. perenne*) was isolated and said to be almost identical with the one present in *L. temulentum* (Jodidi and Peklo, 1929). After extensive observations it was concluded that these endophytic fungi are a special and new type of smut fungus, because they, unlike many other smuts which grow parasitically on wheat, barley and other cereals producing the 'Bunt disease', are typical symbionts. It has been shown also that the hyphæ contain 'prolamin', an alcohol soluble protein and an essential constituent of gluten, the latter being the characteristic protein of cereals and grasses and specially rich in the 'aleurone cells'.* This observation is specially interesting because on the one hand it supports the theory that the aleurone grains represent the products of the symbiotic fungi (Peklo, 1913; Jodidi and Peklo, 1929) and on the other it provides additional evidence to prove the symbiotic nature of the fungus; that is, the fungus, in return for the nourishment it receives from the grain, supplies the grain with protein. Quite a large number of

* Excepting barley seeds, which have 2 to 3 layers of aleurone cells, in the cereals the outermost layer of cells of the endosperm get differentiated from the rest as the aleurone layer. These aleurone cells contain special types of protein crystals called 'aleurone grains' which are sometimes associated with complex inorganic salts like double salts of calcium and magnesium phosphate.

strains of the endophytic fungus have been separated in cultures, a number of them have proved to be physiological strains (Jodidi and Peklo, 1929). The strain which has been called *Lolium* fungus no. 2 may be the apothecial stage of the endophyte (Neill, 1943).

Although endophytic fungi have been isolated from different cereal grains like wheat, barley, rye-grass, etc., the darnel poison which produces the typical symptoms is only present in the hyphæ of the fungus present in the grains of *L. temulentum*. Chemically, this poison is believed to be a pyridine base called temuline. The *Miscara* which was sent to England from Aden for identification and chemical analysis was found to be *L. linicolum* or *L. temulentum* containing temuline.

WHEAT AND LOLIUM

Botanically, *Lolium*, wheat (*Triticum* sp.) and barley (*Hordeum* sp.) are closely related and belong to the tribe *Hordeæ* of the family *Gramineæ*. They differ from each other with respect to the characters of the spikelets and have been placed on that account into separate sub-tribes (Hooker, 1897). As the literature readily available to the toxicologist and public health worker does not contain a good description of the weed, the accompanying photograph (see figures 1, 2, 3 and 4, plate XVIII) of the root, stalk, leaf, ear and grain of wheat and of the weed, side by side, will be found useful in quick identification. The grains of wheat and *Lolium* differ markedly at least in size and can be distinguished as such. There is a sharp microscopical difference between the wheat and *Lolium* starch grains present in the endosperm of each seed. This distinction does not, however, hold good with respect of *Lolium* and barley. Another distinguishing character between wheat and *Lolium* which could be detected under the microscope is the presence of a conspicuous layer of fungal hyphæ between the seed coat and the aleurone layer in *Lolium* seeds which is absent in wheat seeds (Gassner, 1931).

In the present shortage of foodgrains the importance of recognizing the *Lolium* seed, especially in imported wheat, is obvious.

LOLIUM AS AN INTOXICANT

It was reported as early as 1789 (Adam, quoted by Brenchley, *loc. cit.*) that the intoxicating quality of the darnel was known in France, where a narcotic intoxicant liquor used to be produced by brewing barley mixed with *Lolium*. If the intoxicating property of the darnel grains be exploited in future a new aspect of the toxicology of *Lolium* and a new problem in excise will be created.

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NORMAL BLOOD SEDIMENTATION RATE AND OTHER HÆMATOLOGICAL VALUES IN THE PUNJAB

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THIS work has been undertaken to find out the normal standards of blood sedimentation rate (B.S.R.), total red cell (R.B.C.) count, total white cell (W.B.C.) count, hæmoglobin estimation and packed cell volume in normal healthy Punjabis.

TECHNIQUE

Selection of subjects.—Observations were made on 100 healthy normal medical students (75 boys and 25 girls) between the ages of 18 and 26 years. A thorough clinical examination

of the subjects was done and those indicating actual disease or a suspicion of disease were discarded. The cases showing high B.S.R. were examined by specialists and some were screened and x-rayed so as to exclude the possibility of pathological cases in that way also. Blood samples were collected as described by Napier. Mostly they were drawn before the mid-day meals were taken and all examinations were completed within two hours. The following methods were employed in the determination of the various values:—

(i) B.S.R. was determined by the techniques of Westergren (1921) and Wintrobe-Landsberg (1935).

(ii) Packed-cell volume, total R.B.C. count and total W.B.C. count were determined by the technique as described by Napier and Das Gupta (1945).

(iii) Hæmoglobin determinations were done by using Sahli-Haden hæmoglobinometer.

Deductions of the following were made from the above findings thus:—

(a) Mean corpuscular volume:

Volume of packed cells in c.cm. per 1,000 c.cm. blood ÷ red cells in million per c.mm.

(b) Average corpuscular hæmoglobin:

Hæmoglobin in grammes per litre of blood ÷ red cells in million per c.mm.

(c) Mean corpuscular hæmoglobin concentration percentage:

Hæmoglobin in grammes per 100 c.cm. ÷ Volume of packed cells in 100 c.cm. × 100.

RESULTS

1. *Blood sedimentation rate.*—(a) Westergren technique. The average B.S.R. 1st hour was 7.02 ± 5.97 mm. with a range of 0.5 to 23 mm. in the case of male and 14.4 ± 9.74 with a range of 3 to 27 mm. in the case of female. In the table below the results are compared with those of other authors.

TABLE I

Comparison of results of B.S.R. (Westergren 1st hour) with those of other workers

Number	Author	Values	Male	Female
I	Westergren (1921).	Range	1-3 mm.	4-7 mm.
II	Napier	Range	3-15 mm.	5-40 mm.
III	Present investigation.	(a) Range (b) Average (c) Standard deviation.	0.5-23 mm. 7.02 mm. ± 5.97 mm.	3-27 mm. 14.4 mm. ± 9.74 mm.

(b) Wintrobe method. The average B.S.R. by Wintrobe method was 11.2 ± 9.4 mm. with a range of 0.5 to 30 mm. in the case of males and 24.1 ± 9.74 mm. with a range of 7.37 mm. in the case of females.