

Teff. (*Eragrostis abyssinnica*, Schrad.)

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Source: *Bulletin of Miscellaneous Information (Royal Botanic Gardens, Kew)*, Vol. 1913, No. 1 (1913), pp. 32-39

Published by: Springer on behalf of Royal Botanic Gardens, Kew

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390. *Eulophia latipetala*, Rolfe in Dyer Fl. Cap. vol. v. sect. iii. p. 41, anglice ; species distinctissima, a praecedente foliis et petalis multo latioribus facile distinguenda.

Folia fasciculata, 5-7, late lineari-oblonga, attenuata, 5-7-nervia, basi conduplicata, 10-30 cm. longa, 2.5-4 cm. lata, basi vaginis 2-3 brevibus obtecta. *Scapi* erecti, crassiusculi, 30 cm. longi, basi vaginis numerosis latis imbricatis obtekti ; racemi desiusculi, 6-12-flori. *Bractee* lineari-lanceolatae, acuminatae, 2-2.5 cm. longae. *Pedicelli* circiter 1.2 cm. longi. *Flores* majusculi. *Sepala* ovato-oblonga, acuta, circiter 2 cm. longa. *Petala* late ovata, subobtusa, 2 cm. longa, circiter 1.2 cm. lata. *Labellum* 2 cm. longum, fere 1.2 cm. latum, trilobum ; lobi laterales late rotundati, abbreviati ; lobus intermedius suborbiculari - oblongus, obtusus ; discus basi carinis 3-5 crassiusculis laevibus instructus ; calcar subconicum, obtusum, abbreviatum. *Columna* lata, 4 mm. longa.

S. AFRICA. Transvaal : Houtbosch, Pietersburg district, 1740 m., Bolus, 10,975.

III.—TEFF.

(*Eragrostis abyssinnica*, Schrad.).

JOSEPH BURTT DAVY.

In accordance with a promise made some time since, Mr. J. Burt Davy, Government Botanist, Union of South Africa, has kindly sent the following article on "Teff" in the Transvaal for publication in the *Kew Bulletin*. Former articles on this valuable grass have appeared in the *Bulletin* for 1887, No. 1, p. 2 ; and for 1894, p. 378.

The wonderful success which has attended the introduction of Teff into the Transvaal, has induced me to write an article in order to draw the attention of other Colonies to this remarkable grass. As it was Kew which introduced Teff to the civilised world, it is fitting that an account of it should appear in the *Kew Bulletin*.

Seed of Teff was obtained from Abyssinia in 1886 by the Royal Botanic Gardens, Kew, and was distributed to various Botanic Gardens and other Institutions in India and the Colonies, including Natal. As a result of this distribution the following reports were received :—

BRITISH GUIANA :—It was reported to make "an excellent fine hay" and to mature in six or eight weeks from the time of sowing. "For this purpose Teff is well worth cultivating. It is cleaner and brighter-looking than any other grass, and is readily eaten by cattle and horses." (8.)

INDIA :—In 1887 seed was given to the Rajah of Jashpore, and was reported upon favourably ; "the straw or grass is 4 or 4½ ft. in length and smells sweet. The hill people have taken a fancy to the crop" (6). Mr. J. F. Duthie wrote (16) :—"I have a bad

opinion of it as a food-grain, but think better of it as a fodder." Sown in March, the crop was cut in the beginning of May, but sprang up again into a second growth and yielded a cutting of green fodder early in the rains. Sown in July (the rainy season) and cut in the middle of August, the green crop weighed 16,000 lbs., or from 2000 to 3000 lbs. of dried hay, per acre. At a hill station (Arnigadh) "the hay made from the teff was of exceptional good quality and was greedily eaten by the garden bullocks. When it was offered to them they were being fed upon jowar (*i.e.*, kaffir corn) or sorghum stalks, and, as is well-known, these are remarkably sweet, and cattle, when fed upon them, generally refuse other kinds of dry food until they find that the sorghum is not forthcoming. Our garden cattle, however, seemed to prefer the teff-hay to sorghum, as they would not touch the latter until they had devoured the whole of the teff placed before them! The experience gained here during the last year in the cultivation of teff may therefore be summed up as follows:—

"When sown in the dry season it will yield a light crop of grain, and when sown in the rains it yields little or no grain, but produces abundance of green fodder, which may be cured into very palatable hay where the latter is preferred. In my opinion, teff is destined to become the rye-grass of India, and is well worthy of more extended trial on some of the Government fodder reserves" (16).

AUSTRALIA :—The reports were equally favourable, the value of this plant for fodder purposes being considered exceptionally high. Its chief merits in this respect are the short time it takes to mature and its suitability to thrive in dry, sandy regions, where few other grasses would flourish equally well (8).

NATAL :—Mr. J. Medley Wood, Director of the Natal Botanic Garden, Durban, reported in 1887 (4) as follows:—"I received from the Director of the Royal Gardens, Kew, a small bag of seeds of this plant, which is used in Abyssinia for making bread. The seed is very small, and it appeared to me that it would scarcely find favour in Natal as a cereal, though possibly in some parts of the Colony it might be found useful as a fodder plant. I therefore, after having the seed tested, and finding it quite good, distributed it in small packets to persons willing to give it a trial, and hope in "future report to be able to record the results." In 1888 he wrote (5) :—"This will, as I suspected, have no value as a cereal, in Natal, but very favourable reports have been received of it as a quick-growing fodder-grass." Again, in 1889 (15) :—"It was highly thought of as a quickly-growing grass, though as a cereal it proves, as I had suspected, to have no value in Natal. Whether or no the recipients of the seed have thought it of sufficient value to continue its cultivation, I have no information. De Schonburgk says that it stands drought well, and is a good grazing grass."

As a drought-resisting grain crop, for relieving a famine in India, the introduction of Teff does not appear to have been a success. This result and the details contained in the above reports, suggest the possibility that the Teff introduced was the variety known as *Thaf Tseddia*, the quick-growing, rainy-season sort, described by

the missionary Colbeaux (3) as "of very inferior quality, and the flabby cake, or the 'Tabita,' which is produced from its flour, is as disagreeable to chew as if it were mixed with sand." The slow-growing, or *Thaf Hagaiz* variety, is described by the same writer as requiring nearly five months to mature, or two months longer than the other, and as being of superior quality for human food; "its flour is only advantageously used in making 'Tabita,' a kind of large fermented pancake. The 'Tabita' of Thaf is most easily digestible, and has none of the bitterness of some other kinds of grain."

But its failure as a grain-crop for India may be due entirely to other factors. The yields of grain where it was tried, appear to have been usually too small to be profitable. It should be borne in mind, moreover, that in the work of Seed and Plant Introduction and Acclimatisation, success rarely follows first attempts, whereas perseverance, repetition, study of controlling conditions and removal of inhibiting factors often result in subsequent success. The natural conservatism of native races should also be taken into account. A further cause of failure may have been the lack of a well-organised system of co-operation in field experiments on private farms. Observation and experience show that to overcome indifference or conservatism it is not sufficient to maintain demonstration plots on Government Farms or Experiment Stations, nor to issue publications broadcast, nor, even, to "stump the country" lecturing to farmers. New crops are generally taken up first by theorists or men trying to get rich quickly, to whom the advertisements of novelties in the seed-catalogues appeal; such men are often poor farmers and thus make a failure of what otherwise would be a success, the result being that the new crop gets a bad name.

Had I not adopted a system of co-operative experiments with the Transvaal farmers, by which selected farmers, who knew how to grow crops, were induced to try new and promising things, under supervision, Teff would not to-day have been the success that it is. In spite of the favourable reports quoted above it does not appear to have become established either in Australia or India. As already noted, it was introduced into Natal in 1887, and was distributed among twenty farmers, 17 in Natal, 2 in Zululand and one in the Transvaal; though it was reported in 1888 as being "highly thought of as a quickly-growing grass," it failed to acquire the status of a farm crop, and it was not until after its re-introduction in 1903, and by careful fostering, that it became established. But as Mr. Wentworth Sykes has pointed out (11) "it has now certainly come to stay, as witness the hundreds of tons of hay sold locally last year (1910) on the Johannesburg and Pretoria markets, which is but a little of that sold or fed locally."

In the *Bulletin* article on Tropical Fodder-grasses (8) it is stated (p. 375) that "In dry regions not suitable for permanent pastures, the Abyssinian Teff (*Eragrostis abyssinica*) might be grown during the occasional rains and made into hay. This grass will produce a heavy crop of hay in six weeks from the time of sowing. It is very nourishing, and cattle are very fond of it."

About this time Kew very kindly sent me a little seed to California, where I grew it at the Experiment Station of the College of Agriculture. I was at once impressed with the wealth of hay produced.

But California is a region of winter rains, where Lucerne thrives to perfection, and where Lucerne is therefore the staple forage crop. No one who could grow Lucerne cared anything about putting in an annual hay crop, like Teff; and Lucerne being in the ascendant, no farmer had room or time for it.

When I came to the Transvaal in 1903 I brought with me seeds of the most successful grasses which I had grown at the Experiment Station there, such as Teff and New Zealand Tall-fescue (*Pestuca arundinacea*). Most of these did well, and from the start Teff was a great success. In my Annual Report for the season 1903-4, dated 26th October, 1904, I wrote (9):

“Teff (*Eragrostis abyssinica*) is an annual grass of Abyssinia, leafy and fine in quality and 2 to 4 ft. high, seeding heavily; it makes very rapid growth, maturing in 7 or 8 weeks from time of sowing, and if cut before the seed develops, a second crop can be obtained from the same stand; it makes an excellent catch-crop for hay, two successive cuttings being obtainable during the summer on un-irrigated land. The plants seed heavily, our yield of seed from a small plot having been at the rate of about $\frac{3}{4}$ of a ton (1500 lbs.) per acre; the seedlings are not readily scorched by the intense heat of summer, which is a most important point in this climate; its adaptability to our conditions is shown by the way in which ‘volunteer’ seedlings came up all over our Experiment Grounds, under the most adverse conditions. Stock eat this grass readily, both green and when made into hay. Teff is a most promising plant for further experiment. . . . Seed is now offered by French dealers at about 3s. 2d. per lb.; it weighs about 63 lbs. per bushel.”

Seed harvested from this crop was distributed among selected farmers in different districts of the Transvaal, for trial under ordinary farm conditions and to test its adaptability to different parts of the country. My system was to issue the seed free of all cost to the farmer, who signed a written undertaking to return to me from his crop twice the amount of seed supplied. In the case of failure of his crop this condition was not enforced. The majority of *bona fide* farmers loyally carried out their agreement, and where they desired to retain all the seed for further experiment, they often offered to pay cash for it.

In my report for 1904-05 (p. 248) I wrote:—“Mr. V. L. Robertson, of Amersfoort, reports:—‘In this grass [Teff] I think we have struck the desired hay for the High Veld; sown November 6th, it was 3 ft. high in February and ready for cutting for hay; if cut then it would have matured for a second crop of hay in April. Its yields of hay per acre must be tremendous. On account of the soft, thin straw, it dries and cures very quickly. Of all my experiments this has pleased me more than any.’

“The general consensus of opinion is that Teff is a most valuable hay-grass. Under favourable conditions it will mature in two

months from seed ; the seed scatters easily and freely, readily producing a volunteer crop. The yield of seed is remarkable heavy [rendering it cheap and easily obtainable]. The fact that the farmers appreciate the crop is practically illustrated by the requests received for permission to retain, and pay cash for, Teff-seed which is due to the Department as a return for the seed originally supplied."

In February, 1905, my then Assistant, Mr. Hugh C. Sampson, B.Sc., writing in the *Transvaal Agricultural Journal* (Vol. iii, p. 547), noted that Teff sown at the Botanical Experiment Station on November 26th, 1904, was cut for seed on February 20th, twelve weeks from sowing, and gave a yield of 10,285 lbs. of green forage per acre, having had only 7.12 inches of rain during the growing period. "Though it has only been cut two days, the roots are already starting new growth for a second cutting."

In my Report for 1905-06 (p. 112) I noted that "out of twenty-two reported co-operative trials all but two were unqualified successes, and the failures were due to locusts and hail; farmers cannot speak too highly of this crop. One of them writes:—'This can no longer be looked upon as an experiment; its success is assured.' The consequent demand for seed is greater than the supply, owing to the fact that nowhere else than in Abyssinia has this become a commercial crop. By next season, however, I expect that all difficulty in this direction will have been overcome, as so much ground is being sown down to Teff this year."

In my Report for 1906-07 (p. 175) my Assistant at that time, Mr. H. Godfrey Mundy, reported that out of 28 co-operative experiments, carried out in all parts of the Transvaal, 21 were entirely successful; in one case a yield of 4 tons of hay per acre being reported. It was also highly spoken of, in several cases, as a smother-crop for weeds. A progressive farmer in the Wakerstroom District wrote: "It is a grand stand-by at the end of the winter and I don't expect to be without it in the future. All stock are fond of it and do well on it if cut before the straw gets strong. I am now selling seed." From the Ermelo District a farmer wrote: "I have grown Teff most successfully and have supplied farmers round about me with over 100 lbs. of seed free!"

During this period, the demand for seed almost exceeded the supply and the price ranged from 1s. up to 5s. per lb. With increased production, this fell to 9d., 7d., 6d., 5d., and finally 4d. During 1911 I had offers of seed from farmers which totalled over 100,000 lbs.; and this year (1912), one farmer alone has produced 60,000 lbs., which he is selling at 4d. per lb. in 100 lb. lots or 5d. retail.

But although Teff took with the progressive Transvaal farmer, from the start, the hay did not become a commercial article till some years later. As is usually the case with new farm crops, Teff hay did not sell well when first offered. But it was first grown for farm consumption, and only the surplus crop was put on the Johannesburg market. I well remember how disappointed I was at the reports of the earlier sales; they brought no more than ordinary rough veld-bedding, and were in fact bought for the same purpose! But that

was only because the townsman did not know anything about the new hay. Steps were taken to have trial lots tested by large consumers ; but to move a market requires either the whole-time energies of a shrewd business man or some fortuitous accident. I had other things to do, and could not act as Trades Commissioner for the introduction of Teff-hay on to the Johannesburg market ! But the accident happened. As far as I can learn the details, they were as follows :—

A farmer having more Teff-hay than he required for the consumption of his stock, decided to sell the surplus, and sent it to the Johannesburg market. As stated above, it did not sell well ; none of the buyers knew the stuff, and it finally went for bedding. This was disappointing and I personally was afraid it might check the spread of the new crop. But I need not have been afraid. Evidently the low price paid the grower, for it was only his surplus, and his own use of the bulk of the crop doubtless paid him well, leaving the surplus for extra profit. He, and others, continued to send small lots, which were also bought for bedding. As bedding, Teff is softer than the ordinary bedding cut from vlei sedges and *Arundinella Eckloni*, and one lot was therefore selected by the buyer for a racing stable, as being superior to the ordinary. Rumour has it that the owner of the stable found that his racers ate their bedding in preference to the hay in their racks ! Being an observant man, and realising that the price he had paid for the bedding was much lower than that of Lucerne hay or oat forage, he decided to buy more and feed it. To his surprise (the story goes) his horses not only ate all the Teff-hay, but began to put on condition ; then he bought up all that was put on the market and called for more. Others soon got wind of this, and the price rose. It was not long before it had risen from 1s. per bale or £1 per ton till it commanded the same price as Lucerne hay, *i.e.*, 7s. 6d. per 100 lbs. or £7 10s. per Colonial ton.

Once a market was established, the production went up by leaps and bounds ; the markets were soon flooded, and the price fell to a normal figure ; but by this time farmers had learned the value of Teff-hay for consumption on their own farms, and when it did not pay to rail it to market, they fed it. Two years ago I never again expected to see Teff reach a high figure, but the unprecedented drought of the winter of 1912, following a season in which the rainfall (in Pretoria) was 7 inches below the average, has raised the price of hay and fodder so that Teff has again been selling at £7 10s. per ton in Johannesburg.

Since the Union of the four South African Colonies, I have distributed seed to the other Provinces of the Union, and am glad to find that it is taking hold in the Orange Free State, Natal and the Eastern Province. A good deal of seed has been sold by Transvaal farmers to Rhodesia, and some to Nyasaland, British East Africa, German South-West Africa, the Congo State, and Portuguese East Africa, so there is reason to expect that Teff will, ere long, become a staple hay-crop throughout civilized Africa.

Composition.—Analyses of Teff-hay made by Herbert Ingle, F.I.C., late Chief Chemist of the Transvaal Department of

Agriculture, show (14) that Teff-hay has as well-balanced an albuminoid ration as oat-hay. The following comparison is made from the figures supplied in Mr. Ingle's Report:—

—	Teff-hay.		Oat-hay.	Boer Manna.		Lucerne hay.
	A.	B.		A.	B.	
Moisture	8.88	9.16	8.00	8.25	6.54	7.97
Ash	5.55	6.71	4.23	7.78	6.06	8.94
Protein	6.21	4.72	5.65	5.00	4.90	15.49
Soluble Carbohydrates ...	39.08	42.71	44.04	46.24	38.93	30.58
Ether Extract	1.21	1.07	3.87	1.88	1.07	2.36
Crude fibre	39.07	35.63	34.22	30.85	42.50	34.76
	100.00	100.00	100.00	100.00	100.00	100.00
Albuminoid ratio :						
Conventional	1:6.8	1:9.6	1:9.4	1:10.1	1:8.5	1:2.3
Suggested	1:12.8	1:16.8	1:14.5	1:15.8	1:16.8	1:4.4
The ash included :						
Silica	3.25	4.08	2.01	5.67	2.44	0.49
Potash	1.28	1.62	—	—	2.30	3.61
Lime	0.30	0.27	0.18	0.30	0.21	1.38
Phosphorus pentoxide ...	0.24	0.28	0.34	0.32	0.09	0.32
Ratio of lime to 100 of phosphorus pentoxide.	125	96	53	94	217	431

The grain of Teff (Red) has been analysed by Professor Sir A. H. Church (3), whose report is as follows:—

	In 100 parts.
Water	15.2
Albuminoids	8.2
Starch, &c.	68.1
Oil	2.8
Cellulose, &c.	2.8
Ash	2.9
	100.0

“The ratio between the albuminoids, or flesh formers, and the heat-givers, or force producers (calculated as starch) is here 1 : 9. This ratio is less satisfactory than that of the majority of millets, but is near that of *Panicum miliare*” (common or broom-corn millet).

Teff has raised scores of small Transvaal farmers from poverty to comparative comfort, and has been largely instrumental in putting the dairy industry of the Witwatersrand on its feet. The opinion has been expressed by our farmers that “if the Division of Botany of the Department of Agriculture had done nothing else, the introduction and establishment of Teff as a farm-crop would have more than paid South Africa the whole cost of the Division for the ten years of its existence.”

The chief value of Teff as a hay crop lies in its palatability, high nutritive value, narrow albuminoid ratio (for a grass-hay), heavy yield, rapid growth, and drought-resistance. My experience with Teff in the Transvaal is that if sown in October (provided we have fairly good rains to establish the braird), we can obtain a cutting of

about a ton of hay per acre by the first week of the New Year ; at this time we often have 10 days to 2 weeks free from rain, which allows farmers to harvest the crop nicely. Our steady rains usually begin about the middle of January ; these induce the Teff to start fresh growth, which continues till the dry weather begins in March ; by this time another hay crop of 1 to 1½ tons per acre can be cut and cured. Light showers usually occur in March, enabling the Teff crop to make an aftermath which furnishes good pasturage until it is killed by frost.

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IV.—DECADES KEWENSES

PLANTARUM NOVARUM IN HERBARIO HORTI REGII
CONSERVATARUM.

DECADES LXX—LXXI.

691. *Thalictrum Purdomii*, J. J. Clark [Ranunculaceae - Anemoneae] ; species *T. minori*, L., valde affinis sed pedicellis subcapillaribus longioribus, floribus majoribus, sepalis acutis vel acuminatis.

Herba ramis sulcatis rubro-viridibus fistulosis glabris. *Folia* tri- vel bi-pinnata, ambitu ovata, ad 20 cm. longa, ad 15 cm. lata,