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EXPERIENCE WITH GRASS STOP-WASH LINES IN UGANDA

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This article follows as a sequel to a previous article of mine on "Narrow-base Ridges for Erosion Control", published in the *East African Agricultural Journal*, Vol. VII, p. 167 (1942). In that article the cost of making bunds and elephant grass lines was compared, and it was shown that the latter are very much cheaper and are now usually preferred in Uganda where a choice has to be made of one method or the other. It is not to be inferred, however, from the following notes on grass lines that these are advocated for universal use in Uganda. In Buganda Province, the ideal for annual crops is a system of strip cropping with alternate strips under an elephant grass fallow (A. J. Kerr, *Empire Journal of Experimental Agriculture*, Vol. 10 (39), p. 125, 1942), which in itself is usually adequate to control erosion. Elephant grass lines are, however, useful when two contiguous strips have to be cultivated, and also in the closely populated areas around the larger townships where it is impossible to put half the land down to rest. In the Eastern Province, which for the most part is not elephant grass country, strip cropping with grass fallows is also advocated, but where contiguous strips are cultivated, erosion control is by leaving a belt of natural short grass from one to three yards wide uncleared between strips. In all areas grass stop-wash lines have proved of use, with certain qualifications, in permanent crops such as coffee, and, under certain circumstances, in plantains; similarly in Kenya they have been used in perennial crops such as pyrethrum and lucerne.

Grass top-wash lines are coming into increasing use all over the world, and while they are still comparatively new and the subject of much discussion, it is not inappropriate to summarize the experience gained with them in one particular country.

Elephant Grass Lines

Stop-wash lines of elephant grass (*Pennisetum purpureum*, Napier grass) are probably in wider use all over the world than those of any other grass. Thus we read that in South Africa "the grass is often planted on contour banks or in strips across slopes for the control of soil erosion" (W. Schultz, *East African Agricultural Journal*, Vol. VII, p. 118, 1941). In Puerto Rico: "the edges of the terraces . . . . are held by grasses. . . . Numbers of grasses have been tested for this purpose. Elephant grass, *Pennisetum purpureum*, is recommended" (E. Harrison, *Tropical Agriculture*, March, 1942, p. 54). In Kenya, a considerable number of European farmers have tried lines of elephant grass, as well as Native Agricultural School (M. D. Graham, *East African Agricultural Journal*, Vol. VII, p. 104, 1941). In Uganda during 1941 8,341 African plots were planted with elephant grass lines in Mengo District alone; in Kigezi they have become widespread since 1938 and are now a popular idea with the people. It is therefore appropriate to devote the bulk of this article to a discussion of elephant grass lines, more especially as Uganda is one of the chief natural homes of this grass, which is therefore under its natural conditions.

Types of Elephant Grass

Elephant grass in Uganda is a very variable species. Selections made at Kawanda Experiment Station have produced widely differing types suitable for fodder and other special purposes. For stop-wash lines two main types seem to have been used. One is the ordinary Buganda type, freely tillering and with leaves all the way up the stem; this is the one commonly seen in Uganda and also in Kenya. The other may be described as a "scrag-necked" type, since the lower part of the stem tends to become naked while the top bears a plume of leaves; it also appears to tiller less freely than the first type. I have only seen the "scrag-necked" variety in the Eastern Province of Uganda and in Kenya; it appears to be definitely less suitable as a stop-wash, and should be discarded for the purpose. Plates 1 and 2 illustrate clearly the difference between the two types.

In order to reduce the deleterious shade and root effect on adjoining crops (which will be considered below) attempts are being made in the Nsangi Soil Conservation Area to select a dwarf or under-sized form of elephant grass suitable for use as a stop-wash. So far a slightly under-sized form has been isolated, but not sufficiently different from the normal to warrant putting it out as a separate type; selection is proceeding.

Those who plant stop-wash lines will find that there is great variation in elephant grass in such points as tillering capacity, quickness of growth, and drought resistance. They should select according to their needs, remembering

that a good tillering strain will make an excellent stop-wash, but may spread outwards too quickly; a drought-resistant strain with great power of obtaining water will tend to rob adjoining crops; a quick grower will stop erosion sooner, but will need slashing oftener, but again will provide a greater quantity of mulching material.

All classification of types of elephant grass is subject to the qualification that material taken from one district and planted in another with a different climate sometimes shows considerable difference in habit in the new conditions. No two types can therefore be indisputably stated to be either different or identical until they have been proved to be so for genetic reasons.

There is no need to plant grass stop-wash lines on an exactly measured contour, provided a pretty good eye-contour can be laid out. A trench about three inches deep should be dug, and two stems side by side laid all along it and covered with an inch or two of earth. The ends of the stems should overlap, and in dry weather three may be used together instead of two. Stems used for planting should be fresh with the waxy "bloom" still on, and not very old and dry ones. Figs. 3 and 4 show the method of planting. In wet weather the majority of nodes will sprout, and a thick line of elephant grass is quickly obtained; even in comparatively dry soil this method of planting is remarkably successful. An alternative method of planting, by cuttings stuck upright in the soil, does not give good results except in very wet weather; it is, however, a cheap method of filling gaps in the main lines afterwards, if wet weather is chosen for this operation.

In order to prevent unruly growth over the plots and to curb excessive growth, it is desirable to slash the elephant grass back to ground level, or a little above it, at regular intervals. Experience in Buganda suggests that a three-month interval is generally suitable, but a two-month may be desirable in wet weather, and is also to be preferred during the growing period of the cotton crop owing to the bad effect of over-shading on cotton. Observations are in hand to determine the effect of regular two-monthly and three-monthly slashings on the habit of the elephant grass over a prolonged period.

The trash which is obtained from these slashings may at first be disposed of by laying it along the line on the upper side, to increase the stop-wash effect and especially to cover any gaps which may occur in the original line and which might be sources of gullying. After a time, however, more trash will be obtained than can be used in this way, and it can then be utilized in a number of ways—for a stock-feed, for composting, for bedding down animals, for fuel, for building, or for mulching suitable crops. It is this provision of mulching material which has largely recommended elephant grass lines in Uganda, since both the plantain and coffee crops benefit greatly from a mulch; yet to carry elephant grass from any distance is an expensive operation, therefore lines of elephant grass either amongst these crops or in adjacent plots are of great value from this point of view.

Elephant grass lines naturally have a tendency to spread outwards and broaden themselves, and this eventually has to be checked by chopping back the stools or they will take up too much room. In Buganda this point seems to be reached after a period of about three years.

A warning should be given that elephant grass lines should not be planted across land which is not clean of *lumbugu* (*Digitaria scalarum*), otherwise they will harbour this obnoxious weed and endless weeding will be necessary. On clean land the lines do not act as a reservoir of weeds to any serious extent.

Nobody who has seen lines of elephant grass, once thickly grown, can doubt that they will hold up any normal flow of water or earth, and in fact single lines will stand up to very considerable pressures of water when planted across deep gullies. The lines must be near enough together to prevent serious erosion, yet not too near because of the increase in "edge effect". In Buganda a 20-yard interval has been found generally suitable; in the case of grass lines it is better to work by a spatial interval rather than a vertical drop, because on steep slopes the latter will give lines so near together that the "edge effect" is pronounced. Wider intervals than this will often be safe in flatter types of country, but this is a matter which depends upon rainfall and soil type as well as slope, and must be left to local experience.

The degree of natural terracing which takes place along elephant grass lines can be considerable. In Nsangi Soil Conservation Area measurements were made and it was found that, twelve months after planting elephant grass lines in ordinary cultivation along true contours at intervals of a 6 ft. vertical drop (about 18 yards apart), terraces had developed with a vertical drop of 18 inches in many places, and 20 inches at the maximum. On the average, however, terracing in Buganda is not so rapid as this.

It is obvious, both from general considerations and from actual observation, that elephant grass lines, both by shade effect and by root competition, will reduce the yield of crops immediately adjoining them. The effect varies considerably with different crops. Cotton (always a sensitive crop to edge effect) seems to be the worst sufferer, one row and sometimes two next to the elephant grass being often obviously stunted. At the other extreme, sweet potatoes and beans often grow well right up to the elephant grass; other crops seem to occupy an intermediate position. Even with the same crop, there are variations in this respect due to factors which we do not yet understand. Plates 3 and 4 are photographs taken on a Kenya farm in one pyrethrum field protected by elephant grass lines; in Plate 3 the pyrethrum is growing perfectly well right up to the elephant grass, in Plate 4 two or three rows appear to be suffering badly from edge effect.

There is some doubt as to how far this deleterious effect is due to shading, and how far to root competition. In the report already quoted on soil conservation in Puerto Rico, we are told that "Elephant grass, *Pennisetum purpureum,* is recommended, but for narrow terraces on steep land its growth, by creating too much shade, is an objection". from the Bugusege Coffee Experiment Station of the Uganda Department of Agriculture the officer in charge writes of the elephant grass wash-breaks: "It does not appear from observation that there has been any root effect on the coffee" but "the section left to grow for a year produced such excessive shade that the coffee trees were almost killed out". On the other hand, elephant grass roots are known to extend a long way in the same layers of the soil in which crops root. Mr. A. S. Thomas, of the Uganda Department of Agriculture, has taken soil cores to determine the proportions of coffee and elephant grass roots in plots where coffee adjoined elephant grass, and permits me to quote the following table which shows some of his results:—

LENGTHS OF ROOTS OF ROBUSTA COFFEE AND ELEPHANT GRASS IN 480 C.C. OF SOIL

Distance from Coffee	Distance from Elephant Grass	Depth	Coffee Roots	Elephant Grass Roots
		cm.	*cm.*	*cm.*
9 ft.	12 ft.	0–8	108	30
		8–16	130	53
		16–24	92	43
		24–32	42	10
12 ft.	9 ft.	0–8	19	136
		8–16	23	71
		16–24	11	47
		24–32	5	8

From this table it appears that coffee roots must meet considerable competition from elephant grass roots when the coffee trees are at as great a distance as 21 feet from the elephant grass; how serious this competition may be is difficult in my opinion to say, since coffee must also meet competition from the roots of shade trees and other trees, such at Para rubber, which are often deliberately interplanted in coffee without ill-effects. In the opinion of Mr. A. S. Thomas, Economic Botanist, the factor depressing the growth of coffee is that of root competition, not shade, for he points out that both Arabica and Robusta coffee grow wild in dense forests where the shade is much heavier than that thrown by lines of elephant grass.

Another fact, which suggests that root competition is an important constituent of the "edge effect", is that in irrigated plots in Kenya lucerne will grow right up to elephant grass with no ill effect, this being a case in which, owing to the irrigation, competition for water is not likely to be a limiting factor for growth.

There has been a tendency in certain quarters (both in Kenya and Uganda) to condemn stop-wash lines of elephant grass on account of this "edge effect". Before accepting this pessimistic outlook, it should be remembered that the chief alternatives are (*a*) bunds, which are about six times as expensive to make (*b*) lines of natural vegetation, which in many parts of Uganda would again consist of elephant grass. Again, to condemn elephant grass lines is *a fortiori* to condemn elephant grass fallow-strips, which in Buganda have been found to be the most satisfactory method of preventing both soil erosion and soil exhaustion. (A system of elephant grass lines at 20-yard intervals can, of course, easily be converted into one of alternate elephant-grass strips 20 yards wide by treating any two of the elephant grass lines as the outer lines of a strip, and planting up the whole area between with lines of elephant grass at three-feet intervals. It is hoped that the Muganda cultivator will in many cases take this step for himself.)

On the credit side for elephant grass lines should be set their manurial value as mulch-producers, which go far to outweigh any reduction in yield by "edge effect". There is also the fact that after a year or two a thick deposit of rich soil is formed on the upper side of the line, which will offset some tendency to reduced yield by crop plants just above the line. Finally, natural terracing will eventually produce a terrace wall, possibly some feet high, along the lines; and the roots of the elephant

grass, penetrating increasingly into this wall, will compete less and less in the surface soil amongst the crops immediately above and below them.

On the whole therefore it is likely that the good done by stop-wash lines of elephant grass far outweighs the harm. Although crop plants immediately adjacent to the lines may suffer in yield, and tend to catch the eye, on any severe slope the total yield on land protected by such lines will probably be much greater than that on unprotected land, though only very elaborate and prolonged experiments would detect the numerical difference. For coffee, however, it is wise to say that the lines should not be near together (20 yards is again probably a safe interval), and that the elephant grass should always be planted in the centre of an interval between two lines of coffee (African growers by no means always plant their coffee in lines), as elephant grass within two or three feet of coffee trees will certainly be harmful to them. The same applies to elephant grass lines in plantain gardens, but here some further explanation is necessary. The old custom of the Baganda was to plant these gardens on fertile soil, at fairly regular spacings, and to keep the surface of the soil permanently mulched; in such gardens neither soil erosion nor soil exhaustion occur, and it would be something of a sacrilege to plant elephant grass through a really well-tended "lusuku". Nowadays, however, the plantain gardens in the densely populated areas round the townships are nearly all scarred by actual or incipient gully erosion: on the worn-out soils the stunted plantains do not produce enough trash for a mulch; and the gardens are so much interplanted with other crop plants—cassava, coffee, mango trees, Cape lilac, and many others—that in many cases the interspersed plantings could not possibly provide a mulch for the whole surface. In such gardens the only practicable way of reducing erosion is by planting grass wash-stops, for which at present elephant grass is usually the only material available; though with or without these wash-stops the yield from such areas will remain very low.

One other type of "edge effect" may be mentioned before leaving the subject, and that is the depredations on crops of vermin—ranging from rats to ground squirrels—which may find cover in the grass lines. This is not an important factor in Buganda with elephant grass lines, though it becomes more serious with wide strips of elephant grass.

Other Grass Lines

Lemon Grass (*Cymbopogon citratus*).—This grass has been widely used as a small-scale stop-wash in gardens, around buildings, and occasionally in coffee and other crops. It is now widely distributed and quite popular for this purpose amongst African cultivators in Buganda, and has a Luganda name, "kalifuwa". It makes an excellent stop-wash for the first year or two, but is now less recommended because experience has shown that after this the lines tend to become gappy by the death of some of the plants. It is also liable to attack by termites.

Vetiver Grass (*Vetiveria zizanioides*).—Like lemon grass, this was originally introduced into Uganda for the extraction of essential oil, and has now found an alternative use as a stop-wash. It has come into favour as lemon grass has gone out, because it does not tend to become gappy and does not appear to be attacked by termites. On account of its smaller size and root spread, it is probably to be recommended for use in plantain gardens rather than elephant grass, in all areas where it is available. This grass is being multiplied and distributed all through Buganda as rapidly as possible. A line grows quickly from root-divisions planted about nine inches apart. When used as a stop-wash it can be slashed down from time to time like elephant grass, and the cut material makes a useful thatching grass. One complaint is on record from a tea estate in Toro that after some time vetiver grass lines had a bad effect on adjacent tea bushes. On another estate where vetiver grass was planted in proximity to tea, this has not been observed; nor has it been noticed in the coffee experiments at Bugusege, where vetiver grass lines have been used.

Indigenous Grasses.—An obvious one to try was the "tete" grass (*Cymbopogon afronardus*), which is available all over the country in large quantity and is of the same genus as lemon grass. This makes a fairly good stop-wash, but even with repeated infilling it is difficult to get the clumps to grow close enough together to form an impervious line. Another grass which was found being used as a stop-wash by a Muganda cultivator and was fairly useful is a large species of *Eragrostis*, known in Luganda as "buyanja". There is no doubt that there are a number of indigenous grasses which would be of more or less use in this connexion.

(*Received for publication on 9th November*, 1942)

Plate 1—Contour line of elephant grass: Ordinary Buganda type

Plate 2—Contour line of elephant grass: "Scrag-necked" type

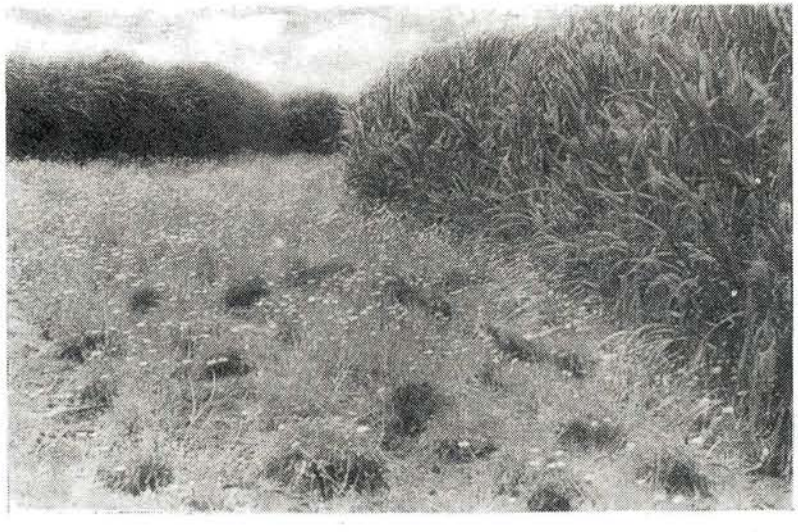

Plate 3—Variation in edge effect: Pyrethrum growing near to elephant grass without ill effect

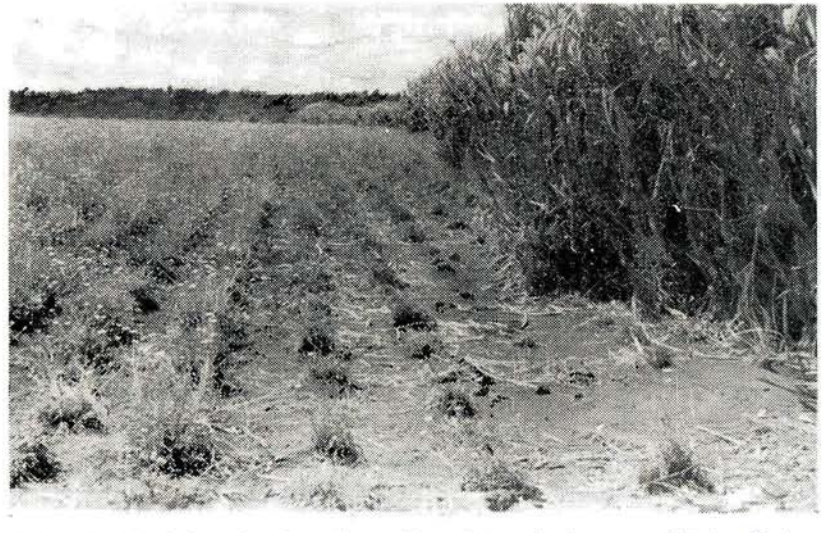

Plate 4—Variation in edge effect: Pyrethrum in the same field suffering from edge effect

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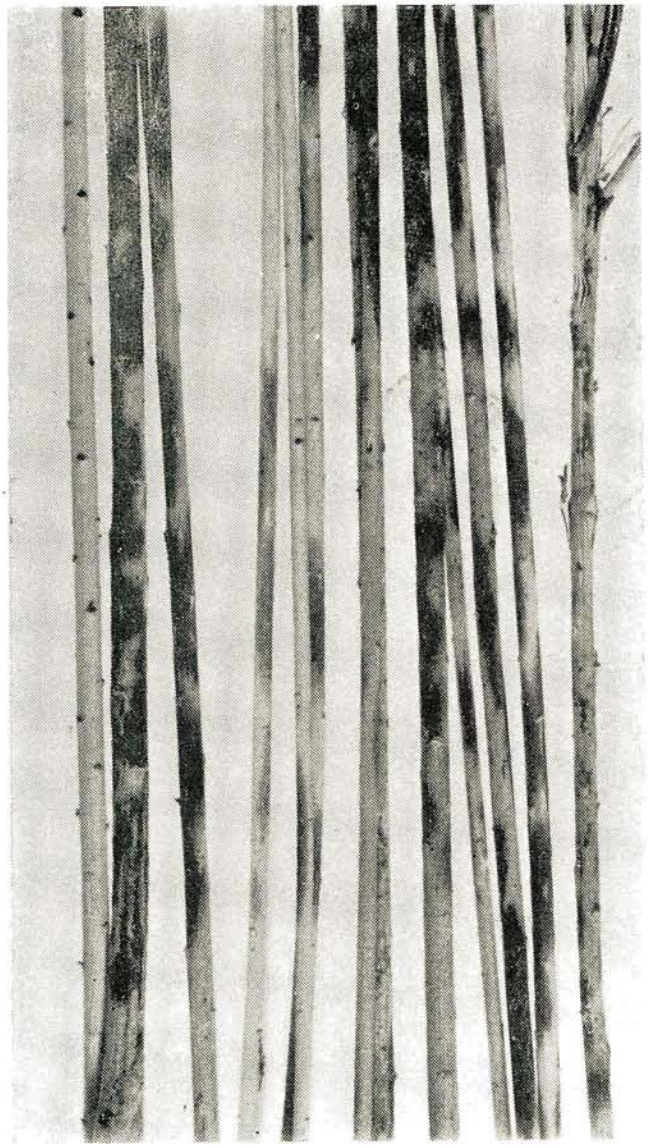
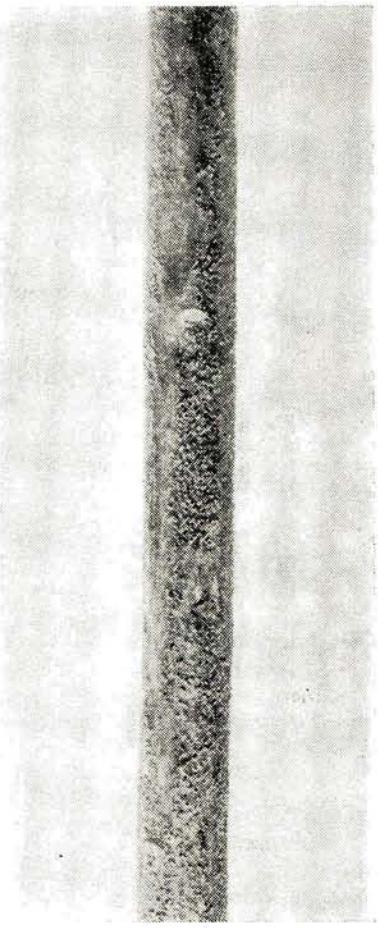


"Pasmo" disease on flax stems.
Natural size



"Pasmo" disease on flax stem showing spore masses extruded from the pycnidia.
× 3 approximately

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