Veld Burning in Natal

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THE subject of veld burning in South Africa is one of the most controversial that can be raised. As with many other subjects, it is one on which people tend to generalise and such generalisations are dangerous, particularly in a country like South Africa with its many variations in veld, soil, and climatic conditions.

Veld fires were common in certain parts of the country long before the advent of the white man (Thompson, 1936) for reports of the earliest Europeans who sailed along the coast stated that the interior was covered by a pall of smoke due to veld fires. That they are a natural phenomenon, in some parts at least, is shown by the number of fires caused annually by lightning in our eastern grasslands (Scott, 1970).

There has for many years been a body of opinion which regarded veld burning as a reprehensible practice which should be prohibited by legislation. As early as 1907, Kanthack, in a very interesting article on the dangers of soil erosion, stated that veld burning was one of the important causes of erosion. He stated that many farmers regarded its use as essential in some area but, in his opinion, it was a dangerous practice and should be prohibited throughout the country by legislation. Further workers just before the first World War claimed that the country was drying up and that one of the causes was veld burning (Von Gernet, 1914).

The first investigation on the effects of veld burning was carried out by E. P. Phillips (1920) just outside Pretoria but this work was

not followed up. Bews (1925) discussed the effects of fire in the evolution of plant forms in South Africa. Early work carried out on the effect of fire in macchia was carried out in 1922 by John Phillips (1931) who has published a great deal on fire in different parts of Africa (Phillips 1930, 1936, 1938, 1959, 1961 and 1965). In 1933 he laid down a series of experiments on veld burning on the University farm, Frankenwald, near Johannesburg. Results indicated that with no removal of grass by burning, the grass died and different times of burning had different effects (Glover and van Rensburg, 1938).

West (1964) published an excellent paper on fire in vegetation and stressed its use in pasture management.

In 1936 the writer was sent to Natal to inaugurate work on two research stations and he found that the problem of veld burning was one of the most important, in certain veld types. Pentz (1938) had carried out a vegetation survey of the area served by the two research stations and had shown that there were three main veld types served by the two stations. Two types occurred on the Estcourt Research Station, one being Thorn or Bushveld and the other Tall Grass Veld. The Tabamhlope Research station was located in Highland Sourveld.

THORNVELD

The Thorn or Bushveld was comprised of shrubs of various heights —mainly *Acacia* spp. up to about 5m and ranged from a density of about 250 to 37000 per ha. The grass storey was composed of species such as *Themeda triandra*, *Panicum maximum*, *Digitaria* spp., *Sporobolus fimbriatus* and various other species which are palatable to stock throughout the year. As a result and owing to the fact that no system of grazing management had been employed, the grass cover of most of the Thornveld area was very sparse and very little burning of the veld took place because there was no grass left to burn. As the grass cover deteriorated, so there was less competition between the grasses and the shrub seedlings for light, water and nutrients and the shrubs increased in number to form dense thickets which competed further with the grass until the ground became virtually bare and soil erosion set in. Veld burning was not a practice in this type of veld. Thus no critical experiments were laid out but a few

exploratory trials were carried out in conjunction with veld management trials.

First an area of about 0.8 ha of moderately open Thornveld was fenced off and protected completely against grazing or burning. The result of protection against grazing during the summer growing period was that the grass cover was restored over the whole area and was able to compete with the seedlings of the thorn trees. Further, the trees which were over a height of about 0.5 m continued to grow but there was not much thickening up in density of the shrubs.

Some of the Thornveld was used for grazing in winter and was rested during the growing season while the rest was rotationally grazed throughout the year. There was a big improvement in grass cover but, with defoliation of the grass at certain times, there was not quite the same competition with the seedlings and they posed an intensification problem. It was found that, where there was enough grass to burn, as a result of resting from grazing, fire controlled the encroachment of the seedlings—but the time of burning was important. Burning in autumn, before the winter dormant season or during the winter, damaged the grass, left the soil bare throughout the dry season and resulted in a disappointing "kill", of the seedlings. Where the grass was left as a soil cover during the winter and burned in spring after rain, the grass recovered very quickly and competed successfully with the seedlings and suppressed most of them. It would thus appear that one method of control of bush intensification in a grazing system would be to rest the veld for the latter part of summer and autumn and burn in the spring after rain. There appears to be no other reason for burning as the grass is palatable even when dry and, if any other method of bush encroachment control could be devised, it would be possible to dispense with burning completely.

TALL GRASS VELD

The Tall Grass Veld (Fig. 1) is a successful open grassland with or without scattered trees of *Acacia sieberana*. The average rainfall is 750 mm per annum. Summer temperatures are high—maximum of 37.2° C—and winters are cool with screen minimum of—5.2° C. The veld has two distinct seasonal aspects. In the early season *Themeda tri-*

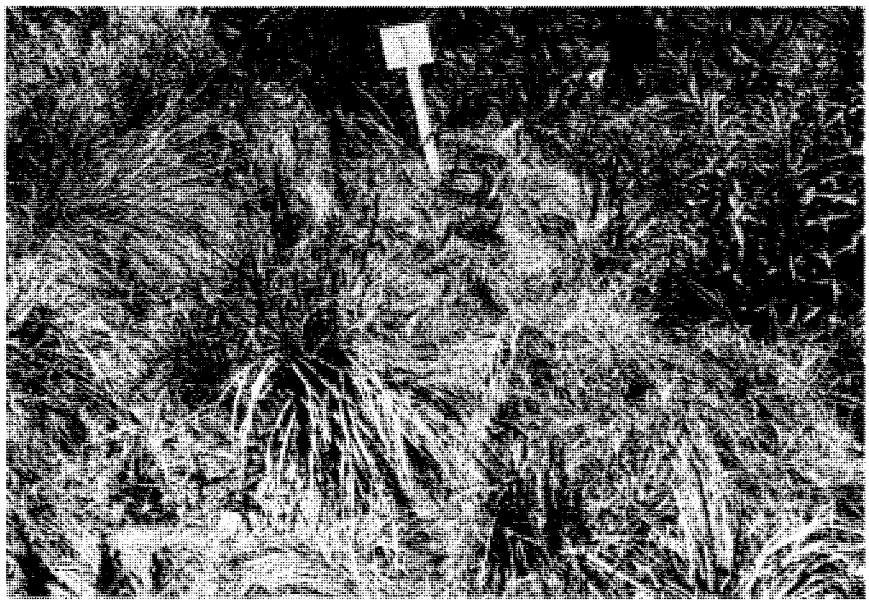

FIG. 1. Tall Grass Veld under complete protection

andra and *Tristachya hispida* are dominant while, from mid-summer onwards, *Hyparrhenia hirta* is dominant. Most of this veld was burned every year and it was found that there were three main seasons for burning: in autumn in order to get a "green bite" before and during the winter, towards the end of July or early August when it was hoped that there would be early spring growth, and after the first rains in the spring which might be any time between the beginning of August and the end of November. Many people claimed that burning should not be allowed as it led to deterioration of the sward and subsequent erosion.

PROCEDURE

Firstly a block of 0.8 ha was fenced with the object of protecting it against burning, grazing or mowing to determine what the plant succession would be under conditions of complete protection. (Fig. 2.) However, the station was very small and the only land available was close to a main road where it was deliberately burned by

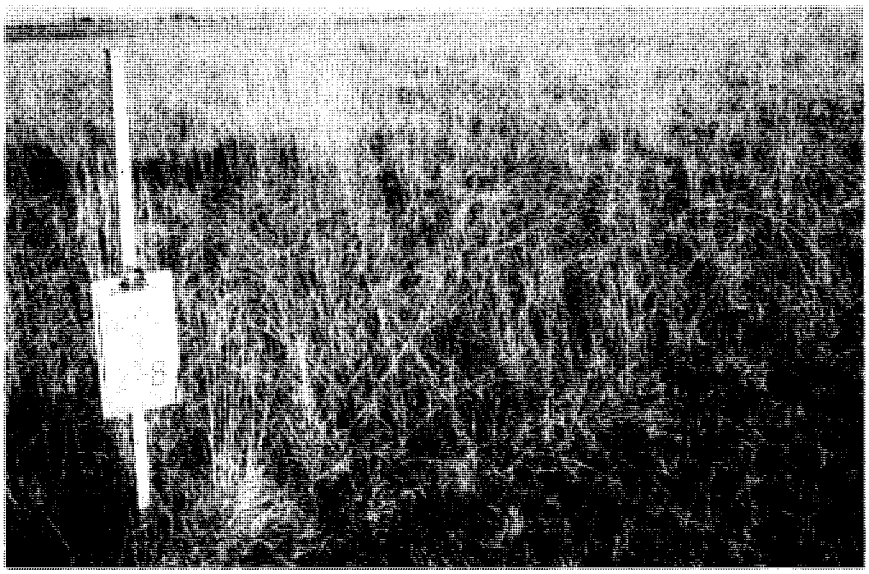

FIG. 2. Tall Grass Veld—annual spring burn before the burn

vandals year after year. Next a big experiment to determine the effects of fire at different seasons and at different intervals without the grazing animal was laid out. This was done because it was felt that, in many cases where veld burning was blamed for deterioration of the veld, there was considerable doubt as to whether the deterioration was not due to the lack of management or mismanagement of the grazing rather than to the fire. The treatments which were laid out on blocks of 0.2 ha were as follows:

(1) No burning or mowing; (2) annual burn at beginning of August; (3) annual spring burn, i.e. after first spring rains (Fig. 3); (4) biennial burn at beginning of August; (5) biennial spring burn; (6) biennial autumn burn; (7) triennial August burn; (8) triennial spring burn; (9) triennial autumn burn: (10) alternate spring and autumn burn; (11) mown for hay during the summer and aftermath mown following spring; (12) mown for bedding each spring; (13) mown for hay during the summer and aftermath mown and burned in alternate seasons in spring.

Phenological observations were carried out on the different treat-

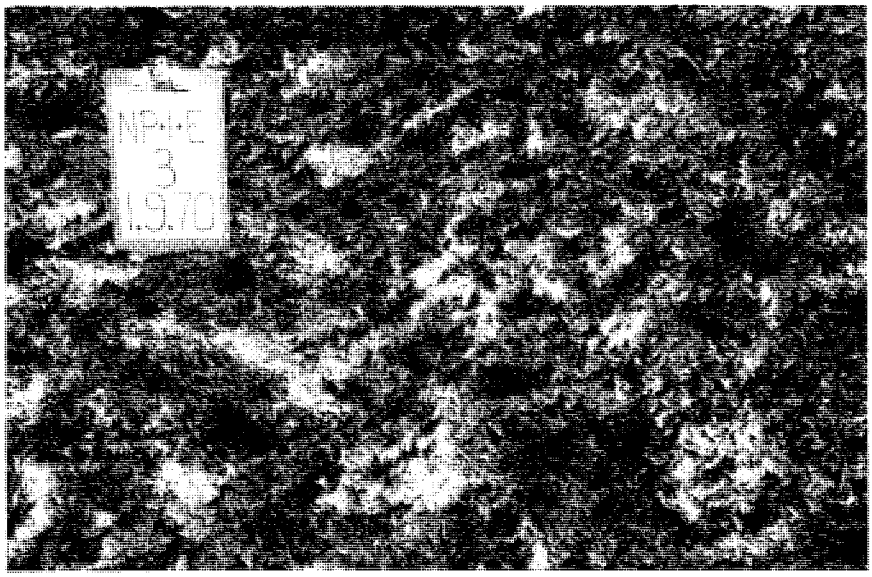

FIG. 3. Tall Grass Veld—annual spring burn after fire

ments and botanical analyses, to determine the basal cover of the various species made at intervals. Up to 1964 run-off and soil loss were measured on selected treatments. These results have previously been reported on by the writer (Scott, 1951), Edwards (1961 and 1968) and le Roux (1968). The experiment was terminated in 1968 and is now being maintained only as a demonstration.

RESULTS

During the period of the experiment, botanical analyses were made on nine different occasions and they all show the same trends. Large differences appeared at first in the botanical composition of the different treatments and there were differences in basal cover. In the seventh year of the experiment, the first rains occurred at the end of November instead of in August–September. Plots which had been burned during the previous autumn and at the beginning of August lay bare for months. This had a serious effect on plant cover and on soil loss when the rains eventually broke. These effects lasted for several years. After that, however, only very small changes in botanical composition

occurred and Edwards (1961) maintained that in practically all of the treatments, the stability of a disclimax had been attained. Certain small changes may take place, such as the appearance of shrubs (not picked up in the point quadrat analysis) in the control plot, but, for the rest of the treatments, stability seems to have been reached.

In Table 1, it can be seen that the plant cover in the control or protected treatment has been very markedly reduced. It was found that after three years of complete protection, most of the grass tufts became moribund and died out. They formed a dense thatch over the soil which prevented the entry of rain and threw it off into the areas between the tufts which acted as gutters. As a result the run-off from the control plot was much higher than from any other while the soil under the tufts was dry and cracked. Normally there was not much soil loss but in certain years, it was very marked. This was found to be due to rodents, using the dense cover of dead grass to make their runs and loosening soil up and down the sides of the run-off plots, which then washed down into the tanks.

The best cover was maintained in the treatments which were mown to remove the grass instead of burning, followed by the spring burns. It is most interesting that the treatment on which hay was cut and the aftermath removed in alternate seasons by burning or mowing, produced markedly less hay in the season it was burned than did the treatment in which the aftermath was mown every year. In the seasons in which they were both mown, the yields were similar. (Scott, 1951; Edwards, 1961; Le Roux, 1968).

The burns at three years intervals showed the lowest cover of all, other than the completely protected plot. This is probably owing to the fact that there was a great deal of dead material after three years, some of the tufts had dried out and there was a slow hot fire.

Although some of these differences in total basal cover are not significant, the general trend has been there in all the analyses made over the years. (Le Roux, 1968).

When the distribution of the four most abundant grasses in the experiment is examined, some very interesting facts come to light. These four grasses react completely differently with different treatment. *Tristachya hispida*, while the most abundant grass on the completely protected plots, is not as abundant as it is on most of the

TABLE 1. PERCENTAGE BASAL COVER—TALL GRASS VELD (1968)

	Control	Annual August Burn	Annual Spring Burn	Biennial August Burn	Biennial Spring Burn	Biennial Autumn Burn	Triennial August Burn	Triennial Spring Burn	Triennial Autumn Burn	Mow Hay Mow Aftermath	Mow Bedding	Mow Hay Mow/Burn	Alternate Autumn Spring Burn
Alloteropsis semi-alata	0.10	0.05	—	0.05	—	0.10	—	0.20	0.05	—	0.30	0.10	0.05
Andropogon amplectens	—	0.25	1.00	0.15	0.55	0.15	0.05	0.10	0.05	0.20	0.35	0.40	0.35
Andropogon filifolius	—	0.05	—	—	0.05	—	0.05	0.10	—	—	—	—	0.05
Aristida spp.	—	—	—	—	—	0.25	0.40	—	—	—	—	—	—
Brachiaria serrata	—	0.10	0.25	0.05	0.10	0.02	0.10	—	0.10	0.10	—	0.10	0.15
Cymbopogon spp.	—	—	—	0.10	—	—	—	—	—	—	—	—	—
Digitaria monodactyla	—	—	—	0.05	—	—	—	—	—	—	—	—	—
Digitaria setifolia	—	0.50	—	0.35	0.15	0.32	0.30	0.10	0.05	—	0.05	0.40	0.05
Digitaria tricholaenoides	—	0.40	0.10	0.10	0.25	0.33	0.30	0.10	0.20	—	0.15	0.05	0.05
Eulalia villosa	—	—	—	—	—	—	—	—	—	0.05	—	—	—
Eragrostis spp.	0.60	0.60	0.20	0.25	0.15	0.22	0.15	0.50	0.30	0.75	0.60	0.85	0.30
Elyonurus argenteus	0.05	0.75	0.80	1.30	1.05	0.53	2.35	0.30	0.15	1.30	1.65	1.15	1.15
Harpechloa falx	—	0.10	—	0.45	0.10	0.25	0.45	0.45	0.15	—	—	0.05	—
Hyparrhenia hirta	0.40	0.05	0.70	1.50	2.60	1.00	0.70	1.65	0.90	0.10	0.40	0.75	1.85
Heteropogon contortus	—	0.75	2.20	0.35	0.20	0.15	0.35	0.10	0.05	1.70	0.20	2.30	0.60
Helictotrichon turgidulum	0.10	0.05	—	—	—	—	—	—	—	—	—	—	—
Koeleria cristata	—	—	—	—	—	0.05	—	0.05	—	0.05	—	—	—
Michrochloa caffra	—	0.20	0.10	0.10	—	0.03	—	0.05	—	—	—	—	0.10
Rhyncelytrum repens	—	—	—	—	0.05	—	—	—	0.05	—	0.05	—	—
Setaria spp.	0.95	0.20	0.65	0.15	0.10	0.28	0.35	0.45	0.05	0.50	0.95	0.60	0.25
Themeda triandra	0.05	6.65	5.70	4.50	3.40	2.03	0.70	0.55	0.30	7.95	5.10	5.35	2.90
Trachypogon spicatus	—	0.05	—	0.05	—	0.02	0.05	—	—	—	—	—	0.05
Tristachya hispida	2.80	1.80	3.20	4.85	7.10	7.58	5.95	7.85	9.95	6.90	7.45	4.30	5.80
Sedges	—	1.10	0.85	0.45	0.20	0.27	0.15	0.10	0.25	0.75	0.70	1.45	0.85
Forbs	1.35	0.60	0.35	0.40	0.15	0.80	0.45	0.65	0.60	0.30	0.75	0.20	0.55
Total Cover	6.40	14.25	16.10	15.20	16.20	14.38	12.85	13.30	13.20	20.65	18.70	18.05	15.10
Grasses Only	5.05	12.55	14.90	14.25	15.85	13.26	12.25	12.55	12.35	19.60	17.25	16.40	13.70

others. It is the dominant grass on the biennial and triennial burns and the mown plots. The only treatments in which it is not abundant are the annual August and spring burns. On the other hand *Themeda triandra* rarely occurs on the protected plot, is abundant on the annual August and spring burns and in the mowing treatments. *Hyparrhenia hirta* was distributed through most treatments and although not the dominant grass in any, was most abundant in the biennial spring burn. *Elyonurus argenteus*, an undesirable grass from the aspect of grazing also occurred in most treatments but was most prevalent in the triennial autumn burn and the treatment mown at the end of winter.

It can thus be seen that the distribution of the most abundant grasses varies considerably with treatment. This, as le Roux (1968) states, is probably the result of the growth habits of the grasses and the protection afforded to the apical buds at different times of the year.

It was possible to lay out run-off experiments on only some selected treatments. These were:

(1) Complete protection; (2) annual August burn; (3) annual spring burn; (5) biennial spring burn; (6) biennial autumn burn; (8) triennial spring burn; (11) mown for hay: aftermath mown in the following spring.

According to le Roux (1968), the run-off from treatment 1 was the highest followed by that from treatments 6 and 2. They were significantly higher than from any other treatment whilst the lowest run-off was recorded from the mown plots. Soil losses were significantly higher from the annual August burn and the triennial spring burn. There was not very much difference between the others. It is rather interesting that the treatments with the highest run-off did not necessarily show the greatest soil losses.

HIGHLAND SOURVELD

The Highland Sourveld is a successional open grassland with patches of relic natural evergreen forest in protected areas. It lies at an altitude of about 1,300m and compromise about 25 percent of Natal. The average rainfall is about 1,000 mm, although during the past five years it has been considerably lower. Summers are cool with a maximum of 36.9° C and winters are cold with a screen minimum of — 15° C. The

frost free period is about 160 days. (Edwards, 1968).

The veld provides very useful grazing in the spring and early summer but becomes unpalatable from midsummer onwards unless very well managed.

Most of this veld was burned every year. Some was burned in autumn, some in late winter and some in spring after rains. All farmers maintain that it would not be possible to farm in this veld type without burning.

It was decided to carry out experiments to determine the effects of burning, mowing and non-burning and the first experiments were laid out in 1936.

Procedures

First a block of 0.8 ha was fenced off in an area of typical veld (Fig. 4). It was protected against burning, grazing and mowing in order to study the plant succession under conditions of complete protection. It was more than a km away from any form of woody vegetation and had been burned annually for many years. It was successfully protected until 1954 when vandals crossed two sets of fire breaks to set it alight. It has not been burned since.

Next a big experiment similar to that laid out at Estcourt except that Treatment 12, Mow for Bedding each spring, was omitted. Phenological observations were made as well as botanical analyses to determine the basal cover of the various species from time to time. Plots, as at Estcourt in the Tall Grass Veld, were 0.2 ha in size. This experiment ran till 1943 and a botanical analysis had been completed when a run away fire swept through the whole experiment. It was then decided to lay out the experiment on another site. The plots, however, were very much smaller being only 100 m^2. Run-off and soil loss studies were carried out on the original experiment but were not continued on the new lay-out owing to lack of staff.

This experiment was burned out by a run–away fire in 1970 and botanical analyses were made in February, 1971.

Results

The protection block has been a fascinating study in plant succession. The original grass cover was composed of low growing species

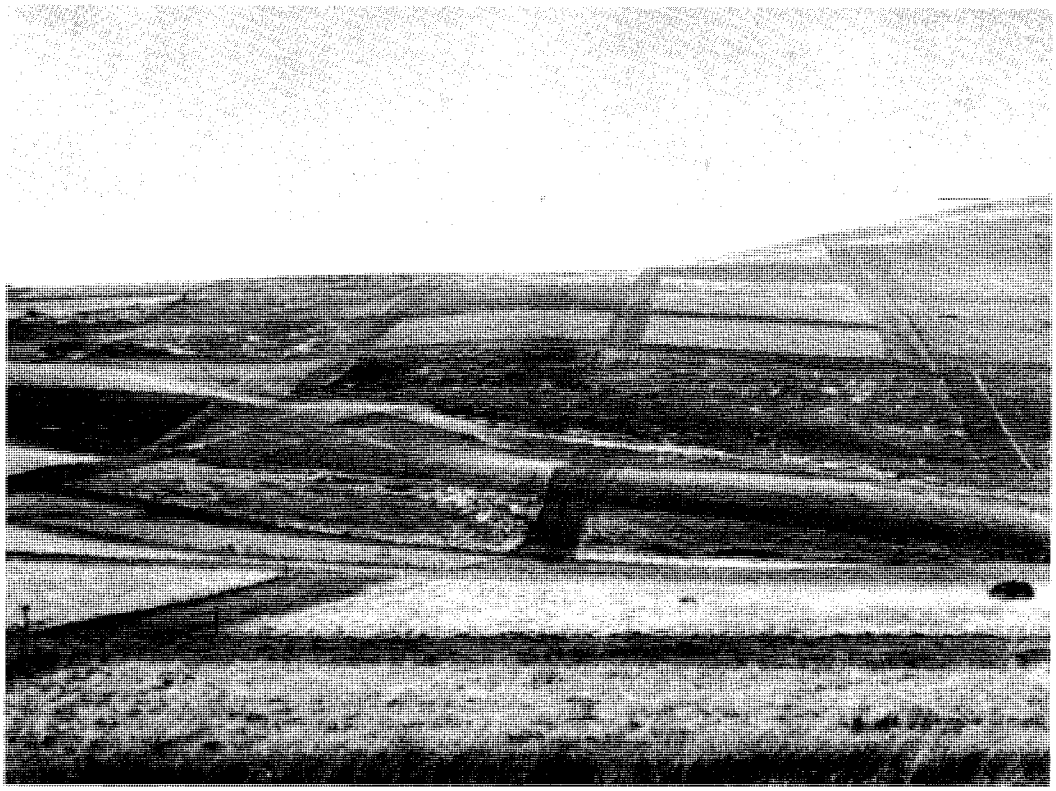

FIG. 4. Highland Sourveld–checker board effect on veld burning experiment

such as *Tristachya hispida*, *Digitaria tricholaenoides*, *Themeda triandra*, *Brachiaria serrata*, *Heteropogon contortus*, *Monocymbium ceresiiforme*, *Panicum natalense*, *Alloteropsis semi-alata*, *Andropogon filifolius*, *Elyonurus argenteus*, *Koeleria cristata*, *Michrochloa caffra* and *Harpechloa falx*. Within three years these grasses became moribund and gradually they began to die out. After a few years tall growing grasses such as *Hyparrhenia pilosissima* began to appear and gradually became dominant. (Fig. 5). In 1954 the whole plot was burned. When the soil was exposed it was seen that the surface was covered with earthworm casts although not one was visible on the firebreaks surrounding the plot. It looked as though everything had been killed by the fire but gradually the tall hyparrhenia became dominant. Then forest margin types of shrubs began to appear until today the plot has the appearance of being covered with shrubs and tall grasses, quite different from the original cover. Fairly frequent are *Buddleias salvifolia*, *Rhus rehmanniana* and *Rhus dentata*. *Hyparrhenia pilosissima* and *Aristida junciformis* are abundant. Other plants also occur but of the original veld grasses there is only an occasional plant of *Allo-*

FIG. 5. Highland Sourveld–annual August burn

teropsis semialata. There is no doubt that if there were a source of seed of forest trees available, the succession in this plot would develop to evergreen forest. It also indicates that the climatic climax of this veld type is forest but is being kept as an open grassland by fire and the grazing animal.

The results of the first experiment which was replaced by one with much smaller plots in 1943 were published by the writer (Scott, 1951). The trends were very much the same in the various treatments except that, with a higher rainfall, there was much more material to burn, particularly in the triennial burns (Fig. 6). Here damage appeared to be greater.

A number of botanical analyses was carried out at intervals on the experiment laid down in 1943. The whole experiment was accidentally burned in a run-away fire in the later winter of 1970. The plots of the protected treatment and those of the triennial burns looked as though they had been completely decimated. The only plots which appeared to have a reasonable cover were the annual August and

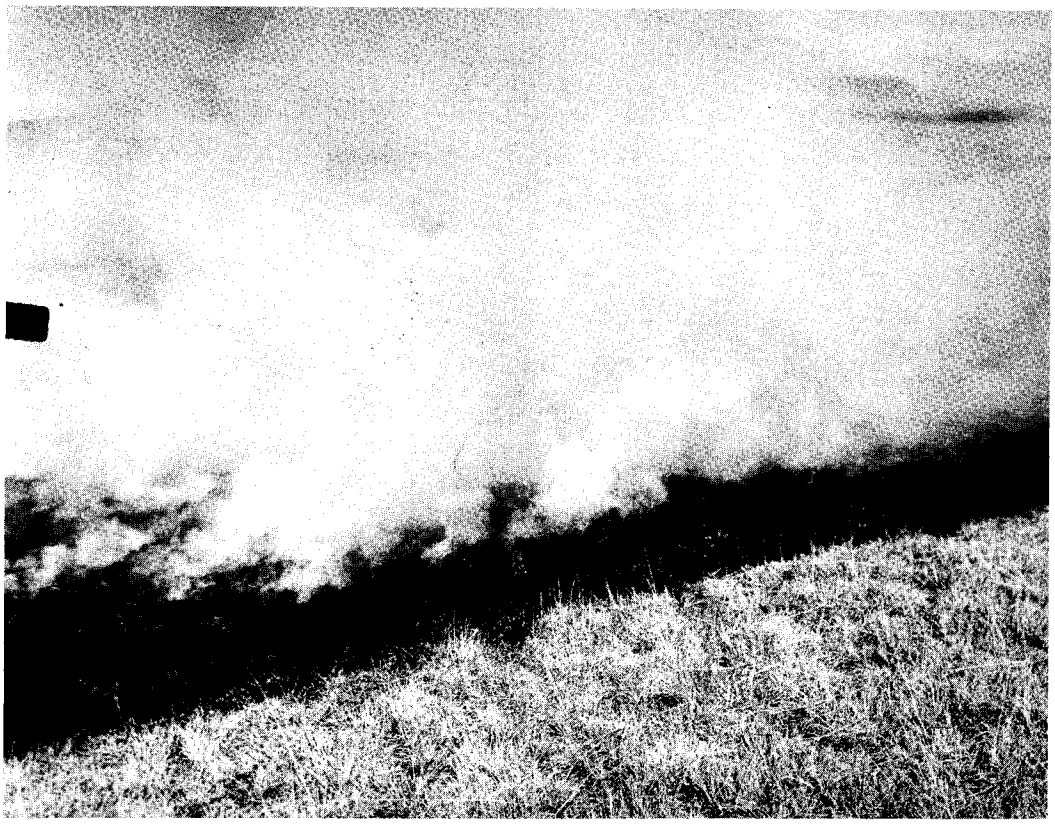

FIG. 6. Highland Sourveld–burning a plot

spring burns and those which usually were mown. The results of a botanical analysis, carried out in February 1971, are given in Table 2.

As pointed out by Edwards (1961) for the Tall Grass Veld, the different treatments appeared to strike a pattern after about six years after which there did not appear to be much change, i.e. the stability of a disclimax had been attained. One characteristic of all the treatments except those which included mowing, in the Highland Sourveld, was the number of forbs that were present and they were far more numerous under complete protection than under any other treatment. As a matter of fact more than 40 percent of the total cover on the protected plot was forbs. There is one big difference between this and the big protection block and that is that, after 28 years protection, there are as yet none of the forest margin species of tall grasses and shrubs. This is probably because the plots are so much smaller that there has been no source of supply of seed of these other species high up in the succession. The grass cover on this treatment is very low, much lower than on any other

TABLE 2. PERCENTAGE BASAL COVER HIGHLAND SOUR VELD 1971

	Control	Annual August Burn	Annual Spring Burn	Biennial August Burn	Biennial Spring Burn	Biennial Autumn Burn	Triennial August Burn	Triennial Spring Burn	Triennial Autumn Burn	Alternate Autumn and Spring Burn	Mow for Hay. Mow Aftermath in Spring	Mow for Hay. Mow & Burn Aftermath Alternate Seasons
Alloteropsis semi-alata	0.0	0.5	1.5	2.0	1.75	1.25	3.25	1.0	0.5	2.25	1.25	0.5
Aristida junciformis	0.25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agrostis eriantha	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.25	0.0	0.0	0.0
Andropogon filifolius	0.0	4.25	4.0	7.0	4.0	0.75	2.50	0.75	0.25	1.25	2.50	5.0
Digitaria tricholaenoides	0.5	0.5	1.0	2.25	4.75	1.25	3.75	5.75	4.0	3.75	1.75	1.25
Elyonurus argenteus	0.25	0.0	0.25	0.0	0.25	0.25	0.25	0.25	0.0	0.0	0.0	0.25
Eragrostis curvula												
E. racemosa	0.5	1.5	1.0	0.25	0.5	0.0	0.5	1.0	2.5	0.25	0.75	0.5
Heteropogon contortus	0.0	3.25	0.5	0.75	0.0	0.0	0.25	0.0	0.0	0.5	5.5	4.75
Harpechloa falx	0.25	0.0	0.0	0.0	0.25	0.75	0.0	0.5	1.25	0.25	0.75	0.0
Koeleria cristata	0.0	0.0	0.0	0.25	0.0	0.5	1.0	0.5	0.25	0.0	0.0	0.0
Microchloa caffra	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.25	0.50	0.5
Monocymbium												
ceresiiforme	0.0	2.25	2.25	0.5	0.0	0.5	0.0	0.0	0.25	0.0	2.5	4.25
Panicum ecklonii												
P. natalense	0.5	1.0	0.75	0.75	0.75	0.75	0.25	0.25	0.25	0.0	0.5	0.25
Themeda triandra	0.0	4.75	3.50	4.25	1.0	0.5	2.25	1.25	0.0	0.0	2.0	2.75
Tristachna hispida	0.25	4.0	7.0	5.0	3.75	9.0	3.5	3.0	2.25	7.25	6.75	3.5
Trachypogon spicatus	0.0	0.0	0.5	0.5	0.0	0.0	0.75	0.25	0.0	0.75	0.25	0.0
Sedges	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.75	0.0	0.0	0.0
Forbs	3.25	1.5	1.5	0.5	1.25	1.50	1.75	1.75	3.5	2.0	0.0	0.25
Total	7.75	23.50	23.75	24.00	18.25	17.00	20.00	16.25	16.00	18.50	25.00	23.75
Grasses Only	4.50	22.00	22.25	23.50	17.00	15.50	18.25	14.50	11.75	16.50	25.00	23.50

treatment and they are mainly what are regarded as less desirable species.

There is very little difference in total cover between the annual August and spring burns and this is probably owing to the fact that the spring rains are usually fairly early and reliable and there is never the long interval between the August and the spring burn that sometimes occurs in the Tall Grass Veld.

Rather strangely the biennial burn in spring shows a lower cover than the August burn which is rather different from the Tall Grass Veld. This trend shows up in earlier analyses too.

The biennial autumn burn, the triennial burns and particularly the triennial autumn burns show much lower cover than the annual burns.

The best cover of all was to be found on the plots which were mown for hay and the aftermath cleaned up with a mower. The next best was that with a similar treatment except that the aftermath was mown and burned in spring in alternate seasons.

The four most abundant grass species on this experiment were *Tristachya hispida, Themeda triandra, Digitaria tricholaenoides* and *Andropogon filifolius*. Their distribution varies greatly with the different treatments just as was found with the four main species in the Tall Grass Veld.

Tristachya does not behave here as in the Tall Grass Veld. It barely occurs in the complete protection plots, is next lowest on the triennial autumn burn (in contracts to the Tall Grass Veld) and is most abundant on the biennial autumn burn. It is fairly well distributed on all treatments.

Themeda triandra is much more consistent here with its behaviour in the Tall Grass Veld. Again it is most abundant in the annual August and spring burns and the biennial August burn. It is not as prevalent on the mown plots as in the Tall Grass Veld but is well represented.

Digitaria tricholaenoides, a rhizomatous grass, is most abundant in the biennial and triennial burns and rather strangely, in view of its growth habit, least abundant on the mown areas.

Andropogon filifolius which is usually regarded as an undesirable grass from the grazing point of view, is commonest on the same treat-

ments as *Themeda triandra,* viz. the annual August and spring burns, the biennial August burns and the mown plots.

It can thus be seen that different grasses have a different response to the same treatments and this opens up quite a field of autecological research. In the cases of *Tristachya hispida* and *Themeda triandra* the study of shoot apex development as outlined by Booysen, Tainton and Scott (1963) may be pertinent.

BURNING AND GRAZING OF VELD

The experiments which have been described in this paper were laid down with the object of determining the effects of complete protection, burning and mowing without the complication of the effects of the grazing animal. After these experiments had run for a few years, grazing experiments were laid down on both stations. The treatments which showed the least amount of harm, except for the complete protection treatment, were laid down under grazing management conditions. The results of this work have been published by the writer (Scott, 1951) and Edwards (1961).

They can briefly be summarized by stating that similar results were obtained in both veld types. Where the veld was protected against burning or mowing, stock tended to concentrate on certain areas and keep the grasses short. Other areas were left ungrazed and these became moribund and behaved similarly to the completely protected plots. As time went on, the grazed areas became heavily overgrazed and the grasses died in the ungrazed sections, showing the need for the removal of the old grass either by fire or mowing.

The best cover and least run-off and soil loss was obtained on plots which were mown instead of being burned and the next best treatment was grazing after being burned biennially in spring.

DISCUSSION

The work outlined in this paper has shown that fire is a very important factor of the environment in the veld types described. There seems little doubt that, were it not for fire, successional changes would occur. These would detract from the value of the different veld types

for grazing. At the same time the results of treatments showing the difference between mowing and burning of the aftermath from the previous year leave no doubt whatsoever that burning affects the production of grass very markedly and that, were it possible to reduce burning, the production of herbage would be much greater. This can be achieved in different ways. First, where the veld is mowable, old ungrazed grass, left by selective grazing can be removed by mowing. Secondly, unmowable veld can be so managed by rotational grazing that burns are necessary only at intervals of several years. Thirdly a new practice has been recommended during the last few years (Scott, 1970). This is the feeding of high protein supplements to livestock during the winter months whereupon they graze the dry and usually unpalatable herbage during the winter and dispense with the need for burning. While this has been advocated fairly widely by stockmen, pasture scientists are conservative in their approach to this practice. If it works successfully, it would mean that thousands of tons of dry grass which normally are burned could be used for the feeding of livestock and so would not be wasted as at present. On the other hand, the grazing of these plants which normally are untouched during the winter period might lead to over-utilization or damage to the grasses which eventually would cause permanent deterioration, worse than that caused by fire.

Burning today is a practice in certain veld types and is likely to remain so for many years to come. This work has shown how important it is to burn at the right time of year and at the correct intervals, these depending on the amount of old grass to be removed.

SUMMARY

Veld burning is a highly controversial subject. Some people think it should be forbidden by legislation; most farmers in the higher rainfall areas maintain that it would not be possible to farm without burning the veld. To determine the effects of fire in three different veld types, some preliminary work was carried out in the Natal Thornveld and critical experiments were laid out in the Tall Grass Veld and Highland Sourveld.

Veld burning is not a common practice in the Thornveld but work

showed that it could be used successfully to prevent bush encroachment if carried out at the right time of the year and in conjunction with good veld management. There would be no other valid reason for burning in the Thornveld.

In the Tall Grass Veld burning is a common practice. Under conditions of complete protection from burning or defoliation the grass cover dies out. If there is a source of seed, the succession may proceed to shrub stage but this is very slow. Run-off is high between the dead tufts of grass which form very good protection for rodents against predators.

The best treatments for the maintenance of a good cover of good species is mowing in the spring or burning in the spring after rain.

In the Highland Sourveld complete protection leads to the replacement of the grass sward, after it has become moribund and died out, by forest margin grasses and shrubs. Mowing of the old grass instead of burning maintains the best cover while there is much damage done by leaving too long a period between burns. Autumn burning is harmful to the cover and in terms of erosion. The generally recommended practice is burning biennially in spring after rain.

Under grazing conditions, it is found that some method of removing old grass must be used if the veld is not to deteriorate. Burning in spring after rain is the commonest practice to achieve this. Removing old grass by mowing gives the best results. The new practice of feeding high protein supplements to enable the livestock to clean up the old grass may do away with the need for burning but the effects of such defoliation are being studied before definite recommendations can be made.

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