Strategy to Control Surface Fire using Vegetational Fire Breaks in Rangelands of Nilgiris, Southern India

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ABSTRACT : To control the spread of surface fire in the rangelands and to check the entry of fire into forest systems from grassland patches, 26 evergreen / succulent species were selected and among them 3 shrubby species such as *Berberis tintoria* Lesch, *Elaeagnus kologa* Schlecht and *Rhodomyrtus tomentosa* Wt. were screened for vegetational fire breaks on the basis of leaf moisture content and some other ecological characters. The fire trail experiments indicate that crossing of fire was checked by the fire belt size of 5 × 1.5 m for all the three species. However, due to higher fire retardant capacity, the fire belt of *R. tomentosa* was effective in comparison to other two species.

Key words : *Berberis tinctoria, Elaeagnus kologa, Nilgiris, Rhodomyrtus tomentosa*, Southern India, Vegetational fire break

INTRODUCTION

Fire is frightening element and its effect on vegetation is largely determined by season of burn, precipitation, size of plant, amount of dead material, growth form, species and whether it is an annual or perennial (Wright 1985). The damaging effects of fire were considered in the categories such as timber values, watershed values, wildlife values, recreational values, grazing values, other property values and socio-economic values (Craig *et al.* 1946). The dry fuel load accumulated in the grassland patches of forests during summer is one of the origin places of fire and from there it can enter easily into the forests (Paulsamy 1992). In Niligirs fire usually occurs in every spring (Feb.~April) and destroys a total area of approximately 500 ha. of grazing land. Hence, the control of spread of surface fire at the point of entry in forest systems may be essential to protect the vegetation from fire destruction. Among the number of fire control methods practiced, construction of vegetational fire breaks as fire barrier is commonly followed and it is important in terms of biodiversity conservation and maintenance of ecological balance (Mutoh *et al.* 1985, McPherson *et al.* 1986, Britton *et al.* 1987, Perara 1992, Rasmussen *et al.* 1996). The established vegetational fire belt need less maintenance and it controls the fire spread at maximum level. The present study mainly aims at to know the identification and screening of certain indegenous evergreen herb/ shrub species and their utility value in fire breaks which are constructed in a *Chrysopogon* sp. dominated grassland of Nilgiris, the Western Ghats, India.

MATERIALS AND METHODS

Since evergreen / succulent plant species are having more fire resistant capacity due to higher leaf moisture, a list of such species have been explored in Nilgiris. Among them, the indegenous species which are having the characters like over 2 m height, distributed in forest areas of Nilgiris, non-palatability and higher leaf moisture content were selected for further study. After collecting the seeds, suitable nursery techniques were also developed for the seedling / sapling establishment of the screened species.

Vegetational fire breaks made by each screened plant species were start to establish in the monsoon month of June 2000 by transplanting the saplings from nurseries to forest edges at a distance of 20 m from forest periphery inside the grassland dominated by the grass, *Chrysopogen* sp. Generally, in India, fire lines (a strip of vegetational area made barren and act as fire barrier) of 1.5 m width are used for fire control practices (Netalkar 1997). Since the maximum height of *Chrysopogon* sp. grass is 1m only, and during burning , fire elevated to a maximum height of 1.5 m in grassland. So it is to be known that 2 m height of vegetational fire breaks is enough to control the jumping of fire flame over the grassland area into forest. Hence in the present study the vegetational fire belts of 1.5 m width with the length of 5 m were planned and established.

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Five replications were maintained for each species. Since the fire belts were developed during monsoon rain period (June~December) no special care was taken except by making fence around the belts which protect the fire breaks from wild animals.

Fire trial experiments were conducted during the second week of February, 2001 with the onset of summer when the fire incidents are mainly occurred in the rangelands and forests of Nilgiris. For the present study, fire has been set arificially in the *Chrysopogon* sp. grassland so as to move towards the windward direction and against the fire belts. During burning experiment, the wind speed was 20 km/hr and the water content of the soil was 9.6~10.5%. The leaf moisture content of test species such as *Berberis tinctoria*, *Elaeagnus kologa* and *Rhodomyrtus tomentosa* was 36, 32 and 40%, respectively. The slope of the grassland area was found to be existed between 16 and 22°. Any incident of crossing of fire over the fire breaks was noticed. The extend of fire damage happened to the species of fire belts was noted one day after fire. The damage was evaluated by calculating the percentage of burned and withered branches. The recovery of fire affected plants was estimated by counting the regenerated branches subsequently after the first summer rain in the middle of March, 2001.

RESULTS AND DISCUSSION

Field visit was made during April, 1999 in Nilgiris to explore the evergreen herbaceous/ shrub species. A list of 26 evergreen / suc-

Table 1. List of evergreen species and data on certain characters used to screen them for vegetational fire breaks in Nilgiris

	Species	Family	Characters			
			Height (m)	Distribution in Nilgiris	Palatability	Leaf moisture (%)
1.	*Agave angustifolia* Haw.	Agavaceae	1	Planted at roadsides	Non-palatable	56
2.	*Berberies tinctoria* Lesch.*	Berberidaceae	2	Inner shola forest	Non-palatable	36
3.	*Cassia tomentosa* Willd.	Caesalpiniaceae	1.5	Roadsides	Non-palatable	25
4.	*Cestrum aurantiacum* Lindl	Solanaceae	3	Wastelands & roadsides	Non-palatable	20
5.	*Cystisus scoparius* L.	Fabaceae	2	Roadsides	Non-palatable	18
6.	*Dodonaea viscosa* L.*	Sapindaceae	4	Forest margins	Non-palatable	15
7.	*Elaegnus kologa* Schlecht.*	Elaeagnaceae	3	Roadsides & forest edges	Non-palatable	32
8.	*Euphorbia rothana* Spr.*	Euphorbiaceae	0.75	Shola forests	Non-palatable	16
9.	*Hypericum mysyrense* Murr.*	Hypericaceae	1.5~2.0	Grasslands	Non-palatable	16
10.	*Inpatiens leschenaultii* Wall*	Balsaminaceae	1	Grasslands	Non-palatable	18
11.	*Mahonia leschenaultii* Tak.	Berberidaceae	4.5	Evergreen forests	Non-palatable	22
12.	*Pilea trinervia* W.*	Urticaceae	1.5	Wastelands	Non-palatable	19
13.	*Polygala arillata* Ham.*	Polygalaceae	1	Openlands	Non-palatable	21
14.	*Polygonum chinense* L.*	Polygonaceae	<1	Openlands	Non-palatable	20
15.	*Prinsepia utilis* Royle.	Rosaceae	1.5	Roadsides	Non-palatable	18
16.	*Rhamnus wightii* W.&A.*	Rhamnaceae	2.5	Hedge plant	Non-palatable	15
17.	*Rhodomyrtus tomentosa* Wt.*	Myrtaceae	3	Shola forest margins	Non-palatable	40
18.	*Rosa leschenaultiana* W.& A.*	Rosaceae	2.5	Shola forest margins	Palatable during lean period	16
19.	*Rubus ellipticus* Sm.*	Rosaceae	2	Shola forest margins	Palatable during lean period	16
20.	*R. moluccanus* L.*	Rosaceae	2	Shola forest margins	Palatable during lean period	16
21.	*R. racemosus* Roxb.*	Rosaceae	1.5	Shola forest margins	Palatable during lean period	17
22.	*Salvia coccinea* Buch'hoz ex.Etl.	Laminaceae	1.5	Roadsides	Non-palatable	17
23.	*Solanum indicum* L.*	Solanaceae	1.5	Wastelands	Non-palatable	16
24.	*Strobilanthes neilgherrensis* Bremek*	Acanthaceae	1.5	Grasslands & Shola margins	Non-palatable	15
25.	*Toddalia asiatica* Lamk.	Rutaceae	4	Semi evergreen forests	Non-palatable	21
26.	*Ulex europaeus* L.	Fabaceae	1	Openlands	Non-palatable	22

* Native plant species growing in Nilgiris and other regions of similar climatic conditions in southern India.

culent plant species were identified and the characters used to screen them for raising vegetational fire breaks are given in Table 1. Among these species, the plants such as *Agave angustifolia, Cassia tomentosa, Cestrum aurantiacum, Cystisus scoparius, Mahonia leschenaultii, Prinsepia utilis, Salvia coccinea, Toddalia asiatica* and *Ulex europaeus* were discarded since they are exotic. In the second step, species of lesser than 1 m height such as *Euphorbia rothiana, Impatiens leschenaultii, Polygala arillata* and *Polygonum chinense* were eliminated because the surface fire in grassland patches can jump over 1 m height. Due to the palatable nature, the Roasceae members like *Rosa leschenaultiana, Rubus ellipticus, R. moluccanus* and *R. racemosus* were also removed from the list. The inhabitants of non-forest areas like *Hypericum mysurense, Pilea trinervia* and *Solanum indicum* have also been eliminated. Since the plants with poor water content in leaves not withstand surface fire (Show and Clarke, 1994), the species such as *Dodonea viscosa, Rhamnus wightii* and *Strobilanthes neilherrensis* (moisture content of 15% each) were not attempted for further study.

Finally, three species such as *Berberis tinctoria, Elaeagnus kologa* and *Rhodomyrtus tomentosa* were selected for further study in the construction of vegetional fire breaks owing to the presence of certain desirable characters like height of over 2 m, growing naturally in and around forest areas of Nilgiris, non-palatability and higher leaf moisture content of over 30% (Table 1). Healthy seeds of these 3 species were collected and suitable nursery techniques were developed during the year 1999~2000 (Paulsamy and Arumugasamy 2001). From nurseries, saplings of *ca.*1m height were transferred to fire belt area (5 × 1.5 m) during June, 2000 and maintained for a period of 9 months until February, 2001 and the individuals of all the 3species, raised in fire breaks attained a height of about 2 m height during this period.

The fire trial experiment revealed that fire has not crossed the vegetational fire belts of all the three species into forest systems. It indicates that the fire belts with the width of 1.5m and height of 2m were adequate to control the jumping of fire. The percentage of fire injuries happened in terms of burned and withered branches is varied across the species (Table 2). The extend of damage was lower in *Rhodomyrtus tomentosa* (burned branches 26.4% and withered branches 14.2%) followed by *Elaeagnus kologa* (burned branches 31.6% and withered branches 21.4%) and *Berberis tinctoria* (burned branches 35.4% and withered branches 18.8%). The higher moisture content of 40% in the leaves may be the possible reason for the presence of fire resistance in the species, *Rhodomyrtus tomentosa.* The percentage recovery of fire damaged branches was also considerably higher (66.4%) for the fire belts made by *R. tomentosa* (Table 3). On the other hand, in other two study species the percentage recovery was found to be lesser than

Table 2. Percentage of burned and withered branches after fire in three species used for the construction of fire breaks

Replicate trial	*Berberis tinctoria*		*Elaeagnus kologa*		*Rhodomyrtus tomentosa*	
	Burned (%)	Withered (%)	Burned (%)	Withered (%)	Burned (%)	Withered (%)
Ⅰ	35±3.2	19±0.9	31±2.3	21±1.5	26±2.2	14±1.1
Ⅱ	39±2.5	15±1.1	26±2.1	26±1.8	24±2.3	12±0.9
Ⅲ	32±2.1	22±1.8	38±2.7	17±1.1	29±2.5	16±0.9
Ⅳ	36±1.1	20±1.5	32±2.8	21±0.9	26±1.8	13±1.1
Ⅴ	35±1.5	18±1.0	31±1.9	22±1.1	27±1.3	16±1.5
Mean	35.4±2.5	18.8±2.6	31.6±4.3	21.4±3.2	26.4±1.8	14.2±1.8

The burned and withered branches were counted throughout the entire stretch of the belt.
± Indicates Standard Deviation.

Table 3. Percent recovery of burned branches in three species used for the construction of fire breaks

Replicate trial	Recovery of burned branches (%)		
	Berberis tinctoria	*Elaeagnus kologa*	*Rhodomyrtus tomentosa*
Ⅰ	40	42	67
Ⅱ	48	46	62
Ⅲ	38	39	70
Ⅳ	45	44	71
Ⅴ	39	41	62
Mean	42.0±4.3	42.4±2.7	66.4±4.3

Recovery of burned branches were observed one month after fire trial experiment.

50% only (42 and 42.4%, respectively in *Berberies tinctoria* and *Elaeagnus kologa*). Hence in high hills of Nilgiris, to control the spread of surface fire effectively, the vegetational fire breaks with the width of 1.5 m constructed by the native species, *Rhodomyrtus tomentosa* may be suggested as fire barrier.

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