GREEN FOREST FIRE BARRIER

Guo Huiru

(Forest Fire Prevention Office, Ministry of Forestry,
Beijing, China, 100714)

ABSTRACT

This article discusses the mechanism of its significant fire-combsting effect and the advantages of living fire-break using certain species of evergreen broadleaf trees which have the peculiar characters of high con-tent, little oleoresin, dense and compact canopy,and leathern, thick leaves. Detail techical standard for its construction is also addressed.

1. INTRODUCTION

Each year,more than 200,000 forest fires break out and destroy millions and millions hectars of woodland, amounting to 1 ‰ of the total existing forest area on the earth. So everywhere in the world,forest fire is considered to be a serious problem in forestry management. Great efforts have been devoted to the strategy and tactics of its prevention and suppression. One of the effective biological methods to combat forest fire is to create living fire-breaks grid by planting proper pyrophyte(fire-tolerant species of trees),according to different site conditions, so as to detain and isolate the spread of forest fire.

2. FUNCTION AND ADVANTAGES OF THE LIVING FIRE-BREAK

Living fire-breaks have the following properties:

(1) High Resistance To Adiant Hrat

General evergreen broadleaf trees can tolerate radiant heat as high as 140,000 k.c./sq.m/hour, six times higher than human's level. Therefore they need a much longer preheating time before cathing fire, which causes a temporary vaccum in continuation of forest fire due to the delay in supply of combustable material. Also they have the capacity of screening heat . Trees of ordianry canopy shape and evenly distributed branches can screen 80-95 % of the heat. Their insulating function increases with the number of tree in the fire-break.

(2) High Water Contents

When heated, the evaporation of the water within the trees of the living fire-break absorbs a great amount of heat and lows the burning temperature consequentially. This could help greatly in checking the fire behaviour.

(3) Fire Checking Effect

The large and dense tree canopy acts like a natural barrier to hold the fire flame and smother air circulation, which prevent the spotting fire and limit the oxygen supply during buning. The large and dense

canopy closure can inhibit the growth of the understorey which makes the main fuel for the surface fire.

In short,owing to their considerable undermining effect on the three basic elements for combustion, i.e. fuel, oxygen and temperature, forest fires can be great weaked by the presence of adequate living fire-break. In some cases, forest fires are even made unable to support themselves and will die out gradually.

Living fire-breaks have certain advantages compared with other measures of preventing the spread of forest fire. Mainly these are:

(1) High Efficiency

Five experiments of fire impact upon living fire-break had been conducted at Dakongshan forest farm, Guangdong Province, and Youxi forest farm, Guangxi Zhuang Minority Autonomous Region respectively. Man-caused fires of considerable intensity were produced from dry combustable materials (dary branches and shrubs) and live standing. The flames exceeding the tree tops by two meters were directed tomards two living fire-breaks consisof ten and twenty years old separately. The fires were feld up by the living fire-breaks and died out by themselves. The damage of the fire to the living fire-breaks was slight: the trunks of the first row of the living fire-breaks facing the flame remained unchanged while about 20-25% of their leaves turned yellow or scorched, few trees as high as 80%. Only 5% of their leaves on the second row facing the fires turned yellow, but the next two were almost intact.In Youxi forest farm, its 130 km long Schima fire-break had successfully protecd over 6700 ha. woodland from forest fire invasions for seven times. All these evidence, both experimental and practical, proved that the Schima fire-break have valuable effect in comb ating forest fires.

(2) Everlasting Viablity

Usually the tree species chosen for the living fire-break are fast-growing. After about 4-5 years, the canopy of the fire-break will close up and begin to shows its fire prevention function, and forever, regardless of the turnover of the surrounding forest. Even the trees in living fire-break could be cut and purposely produce a renewed fire-break composed of different generaitons if we choose species which are capable of sprouting quickly, like Schima, Acacia etc. In this way, the living fire-breaks will maintain its fire protection functions endlessly.

(3) Saving Labor And Investment

At present, the main method of stooping the gradation of forest fire is to open fire lane, mechanicaly or manually, which requires huge amount of labours and funds to cut and, more costly, to maintain it annually. Although to ertablish the living fire-break would cost dearly at the begining. But once it has been finished, the cost of maintaining it is almost negligible. It is economic, in the long run, if we replace the fire lane with living fire-break.It was estimated that in a period of twenty years, the opening and maintaining cost for a piece of fire lane of one kilometer long and 10 meters wide is 843 labor days while a living fire-break would only cost 529 labor days, which means a 40 % less. And the cost of the living fire-break would

be nuch more less if the time span is elongated further.

(4) Promote Land-Use Rate, Stand Volume And Income From Other Forest Products

In Guangxi forest farm, the fire lanes used to occupy an area of about 69.7 ha., which amounts to 3.1% of the total forest area. By changing the fire lanes into chilauni fire-breaks, the land by the fire-breaks, the land used by the fire-breaks was reduced to 39.5 ha., only 2% of the total forest area. Furthermore, these living fire-breaks(17 years old) have a stand volume of 1510 cubic meters timber. In other words, the average stand volume of the living fire-break is 38.2 cubic meters pwe hectar.

Besides their functions in fire protection, living fire-breaks can also be used to produce other forest products. For example, camellia fire-breaks usually bears camellia seed in five years time which is an important oil resource. As for palm fire-breaks, its leaf sheath is widely used in everyday's life for making rope, mattres, brush etc. The collection of the palm sheath starts after five years and reachs peak in ten years. The productivity ability of the palm trees will last for dozens of years.

(5) Help Soil And Water Conservation

Once the cleared fire lanes are replaced by dense living fire-break, the problems typical of bare land surface like rain washing, soil erosion would be xontrolled. The soil structure would thereby improve and soil fertility increases.To demonstrate this, two soil profile examinations were undertaken at Guangxi forest farme, the first was on fire lane in 1964 and the other was under a living fire-breaks which was 10-15 years old at the time of examinaiton in 1983.The analysis results showed that the establishment of the living fire-breaks had greatly improved the physical and chemical properties of the soil sampled: organic material content in the soil under living fire-break increased 59.8%, nitrogen 48.7%, phospharus 35.4%, available phosphate 100%, and available potassium 85% compared with the control sample on bare fire lane.

3. TECHNICAL REQUIREMENTS OF LIVING FIRE-BREAK CONSTRUCTION

(1) Location

The density of living fire-breaks depends on the requirement of the size of fire-confined region, fire danger rating,the value of the forest to be protected and the topography of the location. Given the forest fire should be limited to a patch less than 66.7 ha., then a 15-meter-wide fire-breaks famework totalling 22,045 meters long is needed for a square shaped forest region of 667 ha. . In this case, the area under the living fire-breaks would be 33 ha. , amounting to 5% of all the forest area. If we make full use of the natural features of land relief, like road, river, reservoir, bare rock when designing the fire-breaks grid, the percent of the area taken by the living fire-breaks could be reduced considerably.

The living fire-breaks are artificially divided into two types: main and auxiliary ones. The main fire-breaks usualy go along the boundary between counties, communes, railway line, highway etc. which have

extensive controlling effect on the whole forest district. The auxiliary fire-breaks generally follow the compartment line, lane, ridge,valley etc. whose role is to divide large stretch of forest into smaller units.

In steep, hilly places where the ridges of the mountains are close together, the living fire-break should be built along the ridges where their fire-countrolling effects are most significant. Frequently the soils on the ridges are rather dry and are not suitable for the evergreen broadleaf trees to grow, because the species of trees consume large amount of water in their life. Therefore it will take longer time for the newly planted living fire-breaks to exhibit their fire controlling functions. Instead the moist, fertile valleys provide a ideal habitat for the evergreen broadleaf trees to grow. And it is more likely than not that there are evergreen broadleaf trees occuring at the valleys naturally. In this situation, only some assisting efforts of tending or improving will somewhat carve out perfect living fire-breaks from the natural forest. it is especially important to construct the living fire-break at the bottom of the valleys in the aerial planting forest area. Since these regiongs are universally characterized by few labor hands, difficult accessibility and poor site condition.

Although the desingn of the living fire-break grid should follow the natural characters of the topography of the individual locations, it is also important to include the weather factors under consideration and, if possible, to build the living fire-break vertically to the dominant wind direction in the fire season.

(2) Living Fire-Break Standards

The tree density within the living fire-break is a problem that needs further study. The former opinions the living fire-breaks were uselss were, most likely, derived from the disappointing results of some ill-structured fire-breaks. The flame of a fierce forest fire can easily spot over, penetratr through or creep over the fire-break if it is too narrow or too thin. However, from the other point of view, too wide living gire-breaks would occupy extra woodland area and too large tree density would simply hinder the normal growth of the trees in the living fire-breaks. It is estimatad from the former experiences that the width of the living fire-breaks should exceed the avaerage height of the mature coniferous forest, the main protection target of the living fire-break. The main living fire-breaks shouls be 20-25 meters wide and the auxiliary living fire-breaks be 12-15 meters. The width of the living fire-breaks should increase consequentially in steep terrains.

As a general rule, the tree density of living fire-break should be larger than that of a forest used for timber production,then the living fire-breaks could close up and start to play its role sooner. Also dense living fire-breaks have relatively thick horizontat composition, which create a special microclimate of poor air circulation, high humidity, few undergrowth and fuel over the ground within the fire-breaks. This microclimate could effectively stop the spread of the surface fire. Of course the exact figure of tree density is related to the specific biological features of the tree species

used and the maintainance method followed. The tree density of the living fire-breaks formed by fast-growing, large and dense canopy species should be smaller than the those with slow-growing, smaller canopy species. The tree density of living fire-breaks which are not going to have intermediate cutting should be less than those intended to be cut. The density of Schima fire-break, according to the experiment of Youxi forest farm, should be 3000-3600 per hectar with an spacing of 1.67*2 meter or 1.67*1.67 meter. In four or five years time the living fire-break would close up and begin to play their fire prevention role.

(3) The Structure Of The Living Fire-Break

It is ideal that the living fire-break are of multi-storeies in vertical structure: from large tree down to down to small tree and shrub, and a compact horizontal composition in order to prevent the fire from passing through. But in reality, how to find the optimal structure pattern for a specific location is a very complicated problem which relates to inter-specific relation of the trees, living fire-break management method and many other factors. More fundamental studies are needed in order to solve this problem in the future.

(4) The Selection Of Tree Species For The Living Fire-Break

First, the tree species used for the living fire-break should be evergreen broadleaf trees or deciduous trees but with the same leaf-falling time and these trees could best fit to the specific site conditions of the location. Second, the tree species should have a compact costitution, befire-tolerant and possess little combustable material like oleoresin. Third, the species chosen should grow fast and have strong regenerating capacity, stool shooting and sprouting alike. And the species used for undergrowth shold be shade-bearers. Finally,for the living fire-break composed of coniferous and deciduous species together, the chosen of species should consider the inter-specific relation between them and the forest pest problem of the coniferous forest around the living fire-break. No species of tree which will host or transfer forest pests should be used.

4. ENDING

More and more peoples have known the advantages of living fire-break which preventing forest-fire. The quantity and quality of the living fire-break has more increased, such as in the South of China, there are only the hundreds kilometre living fire-break in the middle of eighties and the twenty more thousands kilometre at present. The way of its construction has been developed the standard and network from scattered. In future soon,the living fire-break will become to the green Great Wall which preventing forest-fire and protecte hundreds of thousands hectare forest resource.