STUDY ON THE TECHNICAL STANDARDS OF FIRE BREAKING TREE BELTS

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ABSTRACT

In this paper new concepts on fire-tolerant trees, fire-resistant trees and fire-proofing trees were presented.Methods for the selection of fire -proofing tree species were presented here for discussion and standards for fire breaking tree belt network were tentatively put forward.

KEY WORDS

Forest Fire, Fire-tolerant Tree, Fire-resistant Tree,Fire-Proofing Tree, Fire Breaking Tree Belt.

Toward the end of 1989, various types of fire-breaking lines had been constructed in the country, totaling to 330,000km long,and an additional 69, 000km of fire breaking tree belts had been established. These have played an important role in the prevention of forest fire, the controling of forest fire spreading and the effort to minimize the damage and loses caused by forest fire.The construction of fire breaking lines,however,is laborious and expensive,needing repairing and investing each y ear and is subject to causing soil erosion, and yet these fire breaking lines are not as effective as fire breaking tree belts. As tree belt has along term quality, is advantageous for water and soil conservation and can produce timber and other by-products, it has been eventually replacing fire break-ing lines as the main measure.

In order to help construct fire breaking tree belts scientifically and make the best use of the advantages of them, the technical standards for fire breaking tree belts are discussed here.

1. Correct definition of fire-tolerant,fire-resistant and fire-proofing trees.

Previously the three concepts were frequently mixed up, therefore could affect the proper selection of tree species for fire breaking belts.They are redefined as bellow.

1). Fire-tolerant tree species: tree species that have the ability to recover,especially the ability to produce new shoots after being damaged by fire. Usually this kind of ability exists in broad-leaved trees whereas lack in coniferous trees. The shooting capability of a tree species may be determined by its shoot-producing ages, seasons and the parts of the plant. Some tree species like larch can only form new shoots as seedlings, some can form new shoots only in periods with the highest growt h and development and some can only form new shoots at highth.These are tree species of weak shoot-forming capability.Some tree species can form new shoots at any age, in any season and at any part of the plant, they are species of strong shoot-forming capability. Species that can form new shoots at base or from roots are especially capable of tolerating fire. Fire- tolerant tree species may also have thicker bark, like *Quercus variabilis* or with bud-protecting tissue, like *Pinus sylvestris*. The latter has vertical top-bud surrounded by lateral buds which consecutively surrounded by needles. Therefore its top-bud will still be able to grow even after all the needles burnt by fire.

2). Fire-resistant tree species:tree species that is not easy to catch fire, and therefore can prevent the spreading of forest fire. These tree species are usually evergreen and broad-leaved. Their leaves and other parts of the plant usually have high content of moisture and low content of resin, have no volatile oil and are rich in Silicon dioxide and other coarse ash contents. They usually have dense foliage with big and thick leaves and strong twigs, which have low calorie and high kindling point. They usually have weak natural pruning and compact canopy with dead leaves and twigs easy to fall off. Tree species of the families Fagaceae and Magnoliaceae belong to this category.

3). Fire-proofing tree species: tree species that can be used for the construction of fire breaking forest belt. They should be fire-resistant and fire-tolerant with certain biological and silvicultural characteristics. Some tree species are fire-tolerant but not fire-resistant, like eucalyptus and camphor tree. They easy to catch fire and thus not fire resistant,but they have strong shoot-producing ability and thus are fire- tolerant species. Tree species like *Nerium indicum* are capable of preventing the spread of forest fire because of their evergreen and dense foliage. But the barks (in this case) are thin, the plant often goes dead entirely after fire, therefore they are not fire-tolerant tree species.Some tree species are both fire-resistant and fire -tolerant, like tree species of the families Fagaceaae and Magnoliaceae. But they have slow growth and weak adaptability, their seeds are difficult to produce and we are still not able to find effecient ways for their-seedling growing and tree-planting and careing. Therefore they are not widely used for construction of fire breaking tree belts.

Tree species currently used for fire breaking forest belts in the country are: Theaceace: *Schima superba, S. argentea, S. wallichi,Camelia pitaidii, C. polyodonta, C. sinensis, Cardonia kwangsiensis*. Myricaceae: *Myrica rubra* . Magnoliaceae: *Michelia macclurei*. Fagaceae: *Castanopsis chinensis, C. fissa*. Mimmosaceae: *Acacia auriculaeformis, A. mangium*. Hammelidaceae: *Mytilaria laosensis*. Aquifoliaceae: *Ilex corallina*. Guttiferae: *Calophyllum inophyllum*.

2. Methods of selection of fire-proofing tree species

1). Field investigation of vegetation in affected areas after fire: capabilities of fire-resistance and fire-tolerance of different tree species can be determined by method of fire-site investigation.According to our surveies carried out in some fire site in Hunan Province, the following tree species can be regarded as fire-resistant and tolerant: *Daphniphyllum macropodum,Lithocarpus glaber,Castanopsis eyrei* and *Euryia acuminatissima*. And the friquent existence of monotypic forest of *Quercus chenii* in our observation indicated that it is a good fire-tolerant species. But it loses its foliage during winter and has thin branch and twigs,therefore it is not a good fire-resistant tree species.

2). Direct burning[1]: In order to get a quick evaluation of the fire-proofing characteristics of a tree species,direct burning under trees of the species with certain amount of fuel spreaded evenly within certain area can be employed. Records of duration of burning, heighth of flame, speed of fire-spreading, damage caused to the trees and the outcome of recovering are then taken into account. This method calls for multi replicae and comparisons and should be carried out in dry (or fire) seasons. The intensity of burning can be calculated by measuring either the calories sent out or the height of flame.

When observations of the recovering ability of the tree species are not needed,the experiment can also be carried out this way:fell trees or cut down big branches, stand them in a certain area and burn immediately. Datae such as height, canopy spreading and ground diameter of the trees (or branches),their total weight,temperatures,humidity and wind speed of the time need to be recorded.

3). Experimental Tests: test the moisture content of leaves and branches, density of canopy, thickness of branches and twigs, size, thickness and quality of leaves, volatile oil and resine content, ash element contents, SiO2 content, burning point and calorific value of the leaves, twigs and branches of the plant, and make judgement from these datae.

4). Integrated Evaluation[2]: take into account of fire-resistance, biological properties and silvicultural characteristics to get a integrated evaluation and set up a series of categaries of fire-proofing capability of different trees by applying fussy mathematical methods. And mathematical models can then be established for multi-purpose decision- making in the integrated evaluation and selection of tree species in the construction of fire breaking tree belts.

5). Visual judgement:factors like whether a tree species is evergreen or deciduous, thickness of leaves and branches, compactness of canopy, thickness of bark, capability to produce new shoots, quality of environment required can be regarded as indications for its fire-tolerant and resistant properties, and thus its possibility as a fire-proofing tree species.

6). Site Planting Experiment:is the best methods to check a good fire-proofing tree species. It make observations of the species' adaptivity, whether it can form a good forest belt and the fire-proofing property of the belt.

3. Optimum network system of fire breaking tree belts.

1). Network structure:of fire breaking tree belts can be classified into 4 categaries: A, B, C and D.A structures are usually constructed for the purpose to prevent the spreading of extremely serious forest fires. B structures are usually for preventing spreading of serious forest fires. C structures are usually designed to prevent the spreading of common forest fires.D structures are designed as barriage against the spreading of warning fires at limited areas, which otherwise can develop readily.

2). Naming forest belts:fire breaking tree belts of A structure network are called trunk belts, those of B structure are called main belts, of C structure are called branch belts and of D structure called supplementary belts. These belts in different categaries are then named in combination with the geographic or/and topographic characteristics of their positions, such as watershede, boundaries of nations, provinces, prefectures, counties, townships and villages, railroads, motorways, mainroads in forest areas, fire breaking tree belts around towns, villages or other civil dwellings,around young forests and along borders of other forests, and thus be called watershede belts, watershede trunk belts, watershede main belts...and so on.

3). Control area of fire shelter networks: According to articles of Forest Fire Provention Regulations of the country, forest fire with affected area more than 1,000 ha is classified as extremely serious forest fire, that with affected area between 1,000 and,100 is classified as serious forest fire, that with affected area between, 100ha and 1 ha is classified as common forest fire and that with affected area less than 1 ha is refered to as warning fires. Therefore control area of A structure network is 1,000 ha, that of B network is 100 ha, that of C network is 10 ha and that of D network is 1 ha.

4). Width of fire breaking tree belts: fire fhelter forest belts in Southern parts of the country are usually established along mountain ridges because there often exists air currents down-slope from ridges. The width of A-structure belts usually is 30-50m,that of B-belts 20-30m, of C- belts 10-15m and of D-belts 6-10m.When the belt form an angle less than 45 degree with the direction of dominant wind during dry seasons, the width of the belt can be lowered by one categary. For example, an A-belts can be designed according to width requiremnets of B-belt when it forms an angle less than 45 degrees with direction of dominant wind of dry season(s).

5). Density of network:is usually refered to as length or area of fire breaking belts in relation to certain amount of total forest area. Density of A-structure network is about 22km/1,000ha,22m/ha,or 66-110ha/1,000ha, and about 6.6-10% of the total forest area. Density of B network is 4km/100ha, 40m/ha or 8-12ha/100ha, and about 7.4-10.7% of the total forest area. Density of C network is 2.2km/10ha or 2.2-3.3ha/10ha and is 18-24.8% of the total forest area. Density of D network is 400 km/ha or 0.24-0.4ha/ha and is about 19.4-28.6% of the total forest area. As networks can make use of rivers,lakes,pools and roads etc.,the actual percentage of shelter networks to total forest area is about 10-20.

6). Choosing optimal network:statistics of the forest fires occured in China between 1949-1987 shows that the average affected area of forest fires was 60ha, and statistics of forest fires occured in Guangdon Province between 1986-1989 shows that the average affected area of the forest fires was 27ha. Therefore C structure network is suggested as the optimal choise in dicision making on fire breaking tree belt network system in the country. This is especially true of Southern China. D network is then eventually developed in newly afforested areas within the C network to complete the whole system.

7). Overview of trial areas[3]: Fire shelter forest network has been constructed in 5, 000ha forest land in three villageships: Jiangken, Banmian and Jingkou of Youqi County,Fujian Province.The network has been designed according to standards of C structure with a total length of 27 0. 64km of fire breaking belts at the density of 54km/1,000ha or 54m/ha. The construction of the network was carried in three consecutive years with total investment 370, 000 Yuan(RMB),ie.74 yuan/ha.Calculating based on belts of Schima spp. , 90 cubic meter timber will be produced in 30 years. Priced at 300 yuan per cubic meter, 7,290,000 yuans'outcom can be expected then,making the ratio of Invest/outcome 1:20.If fruit trees can be planted as an alternative,economic expectation will be higher.

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