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Light Interception, Productive Structure and Production of the *Phragmites communis* Grassland in the Delta of Nakdong River

Chang, N. K. and *H. K. Kang

*Dept. of Biology, College of Education, Seoul Natl. Univ, *Inchon National University of Education*

낙동강 삼각주에 있어서 갈대 초지의 광차단, 생산구조 및 생산성

장 남 기 · 강 호 갑*

서울대학교 사범대학 생물교육과 · *인천교육대학

요 약

낙동강 삼각주에 있는 *Phragmites communis* 초지에서 광차단과 흡수, 생산구조의 계절적 변화, 생산성 현존량을 1982, 1983 그리고 1993년에 각각 조사했다.

횡층화된 수피를 통과하는 빛은 S자형으로 감소한다. 한 식물의 누층적 앞면적은, 그 시기의 수피의 잎면적 생장과 같다. 잎 면적이 log식에 따라 자랄 때, 잎면적의 수직적 누층은 일반적인 역동식에 의해 계산된다. 잎면적의 최대생장률에서의 광차단은 식(1)에 의해 계산된다.

생산구조는 윗부분은 광합성계에 의해, 아래부분은 비광합성계에 의해 차지되어진다. 그러므로, 광차단의 패턴은 S자형에서 지수함수적 패턴으로 변하게 된다.

*P. communis*의 지상부 현존량은 3,660g /m² 이상이었고, 순 생산성은 142g /m²이었다.

갈대초지의 년중 순 생산은 각각 4.10, 4.25, 4.47 kg /m² /year 이었고, 최대잎면적 지수는 각각 10.3, 11.0, 10.4 이었다. 이 결과는 일반초지보다 매우 높은 값이었다.

INTRODUCTION

P. communis is widely distributed in most riverside and seaside with the appropriate water regions. Particularly the pure reed grassland in the delta of Nakdong river is famous in Korea.

Studies on standing crops, annual net production and productivity of reed grasslands in the deltas of Nakdong river were reported by Kim *el al.*(1972), Kim *et al.*(1982), and Chang and Kang(1984).

In this paper, seasonal changes of standing crops of the reed grassland were presented on the basis of the monthly investigations which were carried out in 1982, 1983 and 1993. Productive structures, annual net production and light interception were provided.

METHODS

On the pure *P. communis* community, ten quadrats of 1m × 1m were settled, where above ground parts and under ground parts(depth 35 cm)had been removed. The productive structure was determined by the stratified clipping method of Monsi and Saeki (1953). The sampled plants gathered from each stratum were divided into stems and leaves, which were brought to the laboratory. The samples were dried to a constant weight at 105°C for 24 hrs., ard the dry weight of each organ in each stratum were determined. The vertical distribution of the relative light intensity in the community was measured by PAR (Photosynthetic active radiation) meter.

RESULTS AND DISCUSSION

1. Light interception and productive structure

Relative light intensity passing the stacked leaves of the reed grassland was average 17.3%. Light interception and absorption of the leaves were influenced by thickness, shape, pigments, leaf area and age. This phenomenon indicates that the cumulative leaf area of a definite space in a reed canopy is the same as the growth of leaf area of the canopy at that time(Fig. 1). Therefore, this result is expressed as logistic equation ;

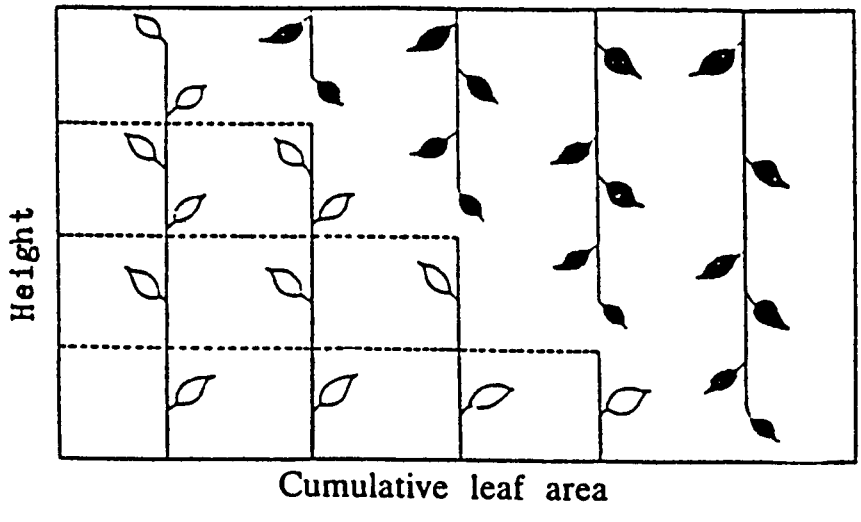

Fig. 1. The relationship between the growth of leaf(black leaf) and the cumulative leaf area(white leaf)

$$I = \frac{I_o}{1+b^{-cf}} \quad \cdots\cdots(1)$$

where, I_o, I, b, c and the illumination above the canopy, the illumination within the canopy heigh h, a constant of intergration, a coefficient of light interception, and cumulative leaf area from top to h height, respectively. The maximum interception of sunlight per unit leaf area is obtained by

$$\frac{dI_{max}}{d_f} = \frac{I_o c}{4} \quad \cdots\cdots(2)$$

As shown in Fig. 2, the curves of sunlight interception by cumulative leaf area were developed from sigmoid pattern to exponential one during the growing season. It suggests that the equation(1) and (2) accord with data meaured in the canopy the pure *P. communis* grassland.

The longitudinal growth of above-ground parts of the *P. communis* grassland is maximum state, 320cm, on 15th July. This result agrees with Kim *et al.*(1982).

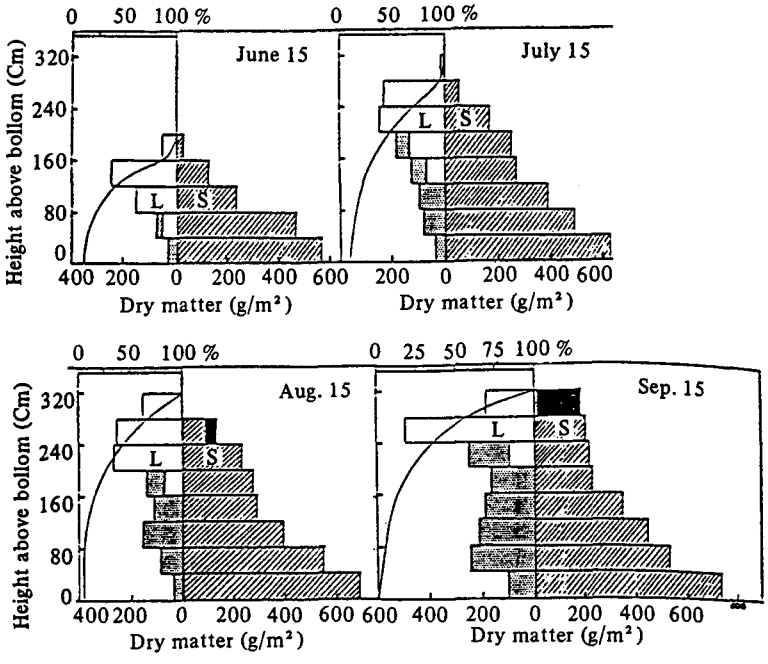

Fig. 2. Seasonal developments of relative sunlight interception and productive structure of the pure *P. communis* grassland in delta of Nakdong river in Korea.
L : leaves, S : stems, ■ : flowers, ▨ : dead parts.

Table 1. Seasoal changes of standing crops and productivity of the *P. communis* grassland in the delta of Nakdong river in Korea in 1993.

Parts \ Sampling Dates	Standing Crop(g/m²)						
	Apr. 14	May 14	June 14	July 15	Aug. 15	Sep. 15	Oct. 13
Leaves	91.5	252.8	500.6	700.4	743.5	772.5	659.2
Stems	274.5	716.2	1,418.4	2,231.6	2,513.5	2,626.5	2,205.8
Total	366.0	969.0	1,919.0	2,932.0	3,257.0	3,399.0	2,865.0
Net prodoctivity above-ground parts	603	950	1013	325	142	−534	
Days between samples	31	33	31	32	32	29	
Average daily productivity	19.5	28.8	32.7	10.2	4.4	−	

2. Dry matter production

Annual and seasonal changes of dry matter production of each organ, and of leaf area index(LAI)were shown in Fig. 3. The seasonal maximum of above-ground parts were attained in late September, and then decreased slowly. The standing crops of under-ground parts decrease to June, and then increase until late September. But annual maximum standing crops of roots is nearly the same. It suggests that the *P. communis* grassland in the delta of Nakdong river is steady state.

Annual net production of the reed grassland in 1982, 1983 and 1993. were 4.10, 4.25 and 4.47kg/m²/year, respectively. This result agrees with Kim *et al.* (1972) and Kim *et al.* (1982), but is very high value, comparing to different sites(Kim, 1975; Chang *et al,* 1976; Lee *et al,* 1983).

The maxinum leaf area indices were 10.3, 11.0 and 10.4, respectively. Yim(1975) reported that the maximum LAI of *P. longivalvis* grassland at Gunja in the Central Korea

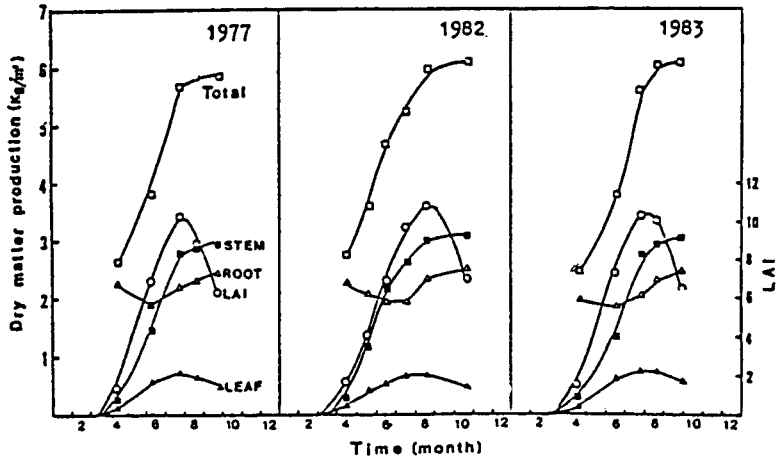

Fig. 3. Annual and seasonal changes of dry matter production of live materials of leaves, stems and of leaf area index(LAI) of the pure *P. communis* grassland in delta of Nakdong river in Korea.

2is 16.0 Kim *et al.*(1972) reported in Nakdong river 13.4~14.3.

3. Productivity

Seasonal changes of standing crops and productivity of live materials of *P. commumis* grassland in the delta of Nakdong river were shown in Table 1.

The maximum average daily productivity is 32.7g /m² /day from 14th June to 15th July and the maximum standing crop is 3,399.0g /m² in September. The net productivity of this grassland was in excess of 142g /m² for one growing season except October.

Average daily productivity of dry matter yield in the reed grassland is initially slow, reaches a maximum and then decrease rapidly until October. This dynamic pattern can be considered to be interaction beween the reed grassland and its environmental factors.

SUMMARY

Interception and absorption of sunlight, seasonal changes of productive structure, productivity, and standing crops of the *Phragmites communis* grassland which was the pure stand in the delta of Nakdong river in Korea, were investigated in 1982, 1983 and 1993.

The light penetration through the stratified canopies is decreased in sigmoid pattern. The cumulative leaf area of a definite space in a certain plant is the same as the growth of leaf area of the canopy at that time. When the leaf area grows according to the logistic equation, vertical accumulation of leaf area in a grassland is given by the general dynamic equation. Light interception at the maximum growth rate of leaf area is given by this equation(1).

The developed productive structure of live materials was occupied by the upper part of photosynthetic system and the under part of nonphotosynthetic system. Therefore, the pattern of the light interception was changed from a sigmoid pattern to an exponential pattern.

P. communis contributed to the standing crops of live materials of above ground parts was in excess of 3,660g /m² throughout the growing season. The peak standing crop, 2,399.0g /m², was reached in September. The net productivity of this grassland was in excess of 142g /m² for one growing season except for octber.

Annual net productions of the reed grassland in 1982, 1983 and 1993 were 4.10, 4.25, 4.47kg /m² /year, respectively, The maximum leaf area indices were 10.3, 11.0, 10.4, respectively, These data were very high in the natural grassland.

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