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STUDIES ON THE NUTRITIVE VALUES OF THE NATIVE GRASSES AND LEGUMES IN KOREA

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To: Minister, Ministry of Science and Technology
Director, United States Agency for International Development

This is the final report of "Studies on the nutritive values of the native grasses and legumes in Korea" by MOST-USAID Trust Fund.

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Contents

Ⅰ. Introduction 1
Ⅱ. Review of Literature 1
Ⅲ. Materials and Methods 3
1. Collected Native Herbage Plants 3
2. Experimental Animals 5
3. Duration of Experiment 5
4. Digestion Trials 5
a. *in vivo* method 5
b. *in vitro* method 5
5. Chemical Method 6
6. Items Investigated 6
Ⅳ. Results and Discussion 6
1. Chemical Composition of Native Herbage Plants 6
a. Chemical composition of green materials 6
b. Effect of stage of maturity on chemical composition 12
(1) Effect of stage of maturity on individual species 12
(2) Effect of stage of maturity on mixed grasses 20
c. Location difference in chemical composition 22
(1) Location difference in chemical composition 22
(2) Location difference in mean chemical composition 27
d. Family difference in the content of nutrients 28
e. Burning effect on the chemical composition 29
f. Relationship between crude protein content and crude fiber content 31
2. Digestibility and Digestible Nutrients of Native Herbage Plants 34
a. Digestion coefficients and digestible nutrients 34
b. Effect of stage of maturity on nutrient digestibility 36
(1) *in vivo* results 36
(2) *in vitro* results 39
c. Digestibility difference between green materials and dried materials 39
d. Relationship between DDM and TDN or DE 41
3. Effect of Fertilizer Application on Chemical Composition and Digestibility of Native Herbage Plants 41
a. Chemical composition 41
b. Digestibility 42
Ⅴ. Summary 43
Ⅵ. Literature Cited 46
List of Tables 48
List of Figures 48
Appendix 1. Chemical composition of hay of native herbage plants (1968) 49
Appenaix 2. Chemical composition of native herbage plants (1969) 51

I. Introduction

In order to increase the number of dairy cattle, Korean cattle, sheep, and rabbits more effectively, it is very important to produce sufficient roughages of good quality. The Korean government has given a great deal of attention and effort to the establishment of improved grassland and pastures in the past five years. However, only 20,000 ha of grassland have been improved and most of the grassland still remains unchanged. Therefore, the native grasses and legumes, including some shrubs obtainable from a large area of the nation (more than 70% of total land), have to be used as major sources of roughage for ruminant animals in Korea.

For effective utilization of native herbages to maximize animal production, it is important to have some data regarding the content of nutrients and digestibility of some dominant native grasses and legumes. Unfortunately, very little work has been done to evaluate the nutritive value of native herbage plants in the past. Therefore, livestock farmers and animal scientists have had to use the compositional data originated from foreign countries to compute balanced rations for ruminant animals.

To evaluate the nutritive value of some native herbage plants in Korea, this trust-fund financed project was carried out for two years from 1968 (1) to determine the content of the crude protein, crude fat, crude fiber, crude ash, nitrogen free extract (NFE), calcium (Ca) and prosphorus (P), (2) to study the effect of stage of maturity on the chemical composition and digestibility of nutrients, and also to see the location and family difference on chemical composition, (3) to determine the digestion coefficients of some nutrients, (4) to compute the content of digestible energy (DE), total digestible nutrients (TDN) and digestible crude protein (DCP), (5) to study the relationship between the stage of maturity and crude protein or crude fiber, (6) to see the relationship between the crude protein and crude fiber, (7) to find out the effect of fertilizer application on the nutritive value of native herbages.

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II. Review of Literature

Kim and Han(1968)[15] studied the growing characteristics, yield and seasonal changes in chemical comgosition of 19 dominant species of native herbages in the rice paddy area of Chungnam-Do. They found that the mean green weight yield per 10 a of grasses and legumes studied was little over 1,000 kg on the average. Crude protein content was gradually decreased and crude fiber content was increased as the stage of growth advanced.

The Institute of Agricultural Science of Seoul National University made a survey mainly for the grassland of Kyunggi-Do area to study the social characteristics, land type, soil characters, grass yield and chemical composition of native herbages. Green grass yield per 10 a was estimated to be 4 tons on the average. Native grassland consisted of 6 10 species of grasses, 5 10 species of legumes and 11 30 species of other families. It was concluded that the dominant species of grasses were found to be *Arundinella hirta*, *Miscanthus purpurascens*, *Themeda japonica*, *Cymbopogon goeringii*, *Zoysia japonica and Festuca ovina*, and the legumes were *Cassia nomame*, *Lespedeza cytissides*, *Lespedeza spp.*, *Lespedeza cuneata*, *Lespedeza striata* and *Dunbaria villosa*.

It was reported by Han *et al.* (1970)[4] that the crude protein content of Korean native herbage was decreased as the growing stage progressed toward maturity and the crude fiber content decreased in a manner opposite to that of crude protein. They also found that dry matter (DM) digestibility determined by *in vitro* method was decreased gradually as the growing stage advanced. Interesting results were also reported by Han and his associates that the crude protein content was much higher and that of crude fiber was much lower during the initial stage of growth after the old native herbage plants had been burned during the preceding month of budding.

Han (1969)[5] found that *Digitaria sanguinalis*, *Pennisetum japonica*, *Phragmites prosturatus*, *Zijania caduciflora* and *Setaria viridis* of grass family and *Lespedeza striata*, *Pueraria thunbergiana* and *Robinia pseudo acacia* of the legumes were relatively good in nutritive value. He confirmed that the content of crude protein decreased as the growing stage progressed. It was suggested that harvesting native grasses in August would be preferable to harvesting in October. Location difference in the chemical composition of native grass was detected. He also found that the crude protein content of native herbages could be increased by application of fertilizer.

Kim (1969)[16] conducted a series of field experiments to study effect of fertilizer application on the yield and chemical composition of native grass species. It was concluded that the plant height and the yield of native grasses were significantly increased by application of fertilizer. In total grass yield *Digitaria sanguinalis*, *Arundinella hirta*, *Eragrostis ferruginea*, *Pennisetum japonica* and *Andropogon micranthus* were superior to orchard grass.

The production cost of some hay from native grasses (*Eragrostis ferruginea* ₩ 6.80/kg, *Digitaria sanguinalis* ₩ 7.00/kg, *Arundinella hirta* ₩ 7.40/kg, *Eragrostis ferruginea* ₩ 9.00/kg, *Ardropogon micranthus* ₩ 9.50/kg) was lower than that of orchard grass (₩ 13.00/kg).

Although the content of nutrients in *Robinia pseudo acacia* leaf meal was higher during the early stage of growth, Kang *et al.* (1969)[11] found that there was no significant difference in crude protein content of acacia leaf meal, if it is harvested before September. However, there was location difference in crude protein content.

Interesting results concerning the effect of preparation method of hay on the nutrient digestibility was reported by Shin *et al.* (1969)[23]. Treatment of high temperature resulted in depression in protein digestibility. Although curing method had no effect on the crude protein content, the content of crude fat, NFE and total organic matter was decreased as the curing temperature increased.

Morrison (1959)[20], NRC (1656)[21] and many other group of the United States; Morimoto (1968)[10], Saito (1960)[24], Iguchi (1954)[8] and others of Japanese workers; Gerpacio *et al.* (1968)[3] of Philippines, and Kang *et al.* (1966)[13] and many other scientists in Korea have recorded feed composition table for their roughages in their publications. However, very limited data on the chemical composition of native herbages are available at the present. This is the reason why Kang *et al.* and many other Korean scientists had to use feed compositional data obtained from many foreign countries to list feed composition tables in their publications.

Chemical determination for proximate analyses of native herbage was initiated in 1958 by Lee (1968)[17] of the Livestock Experiment Station. The results obtained for a considerable number of native herbages are summarized in Research Report of ORD (1968)[16]. Unfortunately, these samples have been collected from a single location with an unknown stage of growth.

Recently the content of calcium and phosphorus for about 50 samples of native herbage was determined by Chiang (1967, 1968)[9,10] and the results appeared in a Research Report of The Livestock Experiment Station (1968)[2]. Some chemical work to analyze Ca and P content of some bone meals and oyster shell were done by Han and Ohh (1969)[6]. This type of work stimulated the development of analytical work for trace elements in feedstuffs.

Yuk *et al.* (1961)[28] reported that the digestion coefficients of crude fat and crude fiber of mixed native hay were relatively high, and the TDN value was much similar to pasture grass hay in the United States. The digestion trials were conducted with 2 sheep for mixed native hay consisting mainly of *Digitaria sanguinalis*. In 1962, 6 Korean cattle bulls were used to determine the digestibility of several home produced feedstuffs by Yuk *et al.* (1962)[27]. Digestion coefficients of nutrients in native grass hay were recorded as follows: crude protein 38.0%, crude fat 38.1%, crude fiber 62.3%, NFE 49.2%. The content of DCP and TDN of native grass hay was 2.6 and 44.9%, respectively.

Digestion coefficients of nutrients in orchard grass hay (crude protein 62%, crude fat 43.0%, NFE 64.4 %, crude fiber 68.9%) determined by 3 Korean cattle were higher than the data obtained from mixed native grass hay by Yuk *et al.* (1962)[27].

Chiang *et al.* (1966, 1967)[11,12] conducted a series of digestion trial with 2 Korean cattle to determine the digestion coefficients of nutrients of 12 feedstuffs such as sweet potato ensilage, rye hay, and *Digitaria sanguinalis*. A part of their results are seen as follows:

Kind of Hay	C. Protein	C. Fat	NFE	C. fiber	DCP	TDN
	%	%	%	%	%	%
Rye hay	49.4	31.3	62.3	78.7	4.37	52.75
Digitaria sanguinalis						
1965	41.6	49.2	66.3	69.2	2.90	49.78
1966	39.2	45.8	60.0	66.7	2.44	43.33

Dry matter digestibility of some native species determined by *in vitro* fermentation techniques was highest in July and decreased gradually as the stage of growth advanced (Park *et al.*, 1969)[24]. Park *et al.* determined the DM digestibility of Russian comfrey, *Calamagrostis arundinacea*, orchard grass and Ladino clover and found the similar results.

Yun (1968)[29] conducted a series of digestion trials with 16 rabbits, New Zealand White, to study the effect of cutting date of *Arundinella hirta* on the nutrient digestibility. The results obtained revealed that the digestion coefficient of nutrients studied was decreased as the growing stage advanced. It was suggested that harvesting in blooming season was preferable to other seasons.

III. Materials and Methods

1. Collected Native Herbage Plants

Some dominant species of native herbage plants as listed in Table 1 were collected from native glassland

area throughout the nation for chemical analyses and digestion trials. In 1968 more than 200 samples had been collected from Yongin (Kyunggi-Do), Songhwan (Chungnam-Do), Southern Jeju (Jeju-Do), Jinju (Kyungnam-Do) and Daekwan Nyang (Kangwon-Do). From Songhwan and Jeju, samples were collected to study the effect of stage of maturity and burning effect on the chemical composition of native herbage species studied. Mixed native hay was also prepared and transported for digestion trials with sheep.

In 1969, more than 700 samples of important species of native herbage plants were collected from 10 different areas of Korea. To study the effect of growing stage on the chemical composition and nutrient digestibility of native grasses and legumes, a sample was prepared three times according to the stage of maturity for given species, i.e., first sample for pre-blooming period (June), second sample for blooming stage (August) and the last sample for post-blooming period (October). The areas from which samples of native herbage species were collected were as follows:

Area	Location
Mountain area	Daikwannyung (Kangwon-Do)
	Jirisan (Chunnam-Do)
Hilly area	Yongin (Kyunggi-Do)
	Andong (Kyungbuk-Do)
	Jinju (Kyungnam-Do)
Island area	Jeju (Jeju-Do)
	Kueje (Kyungnam-Do)
Rice paddy area	Hwasan (Kyunggi-Do)
	Kwangsan (Chunam-Do)
	Yiri (Chunbuk-Do)

Table 1. Name of collected native herbage plants.

Family	Name of native herbage	Family	Name of native herbage
Grass	*Arundinella hirta*	Legume	*Lespedeza cuneata*
	Phragmites prosturatus		*Lespedeza cytissides*
	Themeda japonica		*Lespedeza striata*
	Miscanthus purpurascens		*Pueraria thunbergiana*
	Eragrostis ferruginea		*Lespedeza spp.*
	Imperata cylindrica		*Amorpha fructicosa*
	Zijania caduciflora		*Securinega subfruticosa*
	Paspalum thunbergii		*Dunbaria villosa*
	Cymbopogon goeringii		*Lespedeza bicolor*
	Eulia speciosa		*Cassia nomame*
	Digitaria sanguinalis		*Indigofera koreana*
	Andropogon micranthus		*Astragalus membranaceus*
	Calamagrostis arundinacea	Shrub	*Robinia pseudo acacia*
	Eccoilopus cotulifer		*Betula platyphylla*
	Pennisetum japonica		*Salix glandulosa*
	Agropyrum semicostum		*Quercus dentata*
	Festuca ovina	*Carduaceae*	*Artemisia asiatica*
	Zoysia japonica		*Artemisia japonica*
	Setaria viridis		*Artemisia gigantea*
	Beckmannia erucaeformis	Other	*Carex birvensis*
	Miscanthus sinensis		*Mixed native grasses*

Digestion trials with 12 Corriedale sheep were also conducted for mixed native grasses obtained from Jinju, Andong, Jirisan, Kueje, Yiri and Daekwan Nyung. For this, 70 kilograms of mixed native grass hay from the above area was prepared three times, in June, August and October, by the stage of growth.

2. Experimental Animals

To conduct a series of digestion trials for individual species of native herbage or mixed native grasses, 12 adult Corriedale sheep (male) were used. The average live weight of experimental sheep used was recorded to be about 50 kilograms when they were transported from the Alpine Experiment Station. Upon their arrival in the animal laboratory of Collgee of Agriculure, all sheep were treated with parasite control medicine.

3. Duration of Experiment

This project was initiated in May, 1968 and terminated in June, 1970 as follows;

From		To		Research Activity
May	1968	Dec.	1968	Collection and chemical analyses of samples
July	1968	Feb.	1969	Digestion trials for individual species and mixed grasses
Feb.	1969	June	1969	Chemical work for feces and grass fed
June	1969	Apr.	1970	Collection and analytical work for individual native species
Dec.	1969	Mar.	1970	Digestion trials for mixed native hay
Mar.	1970	June	1970	Chemical determination for feces and data summarization

4. Digestion Trials

Dry matter digestibility of native herbage plants obtained from Songhwan was determined by *in vitro* fermentation method. On the other hand *in vivo* method (total collection method) was also employed to determine the digestion coefficients of nutrients in individual species and mixed grasses of native herbage plants studied. The methods are described briefly follows:

a. *In vivo* method

Experimental sheep were caged in metabolism crate individually for a week (preliminary period) to adjust the feed intake. During the period of collection (5 to 7 days) the exact amounts of feed consumed and feces excreted were recorded daily at 7:00 a.m. Ten percent of the total feces excreted was taken as the representative sample of the day and then dried. The fecal samples were dried individually at 80°C in an air forced drying oven for 24 hours. When the digestion trial was terminated, all the samples were pooled together and processed for futher chemical anslysis to compute the digestion coefficients, and the content of digestible nutrients.

b. *In vitro* method

Two stage fermentation technique developed by Park *et al.*(1968)[22] was used to determine the DM digestibilities of some native herbages. In the first stage, samples mixed with rumen juice and artificial saliva were fermented at 39°C for 48 hours. In the second stage, fermentation with pepsin and hydrochloric

acid was carried out and then filtered using filter paper and hyplo supercell to determine the DM digestibility. Rumen juice used was obtained from fistulated sheep.

5. Chemical Method

The content of moisture, crude protein, crude fat, crude fiber and crude ash was determined by the method described in AOAC (1960)[1]. The nitrogen free extract fraction was calculated by subtracting the percent of moisture, crude protein, crude fat, crude fiber and crude ash from 100.

Calcium concentration was determined by the titration method of $KMnO_4$. The spectrophotometric method was used to analyze phosphorus content. Calorific value of native herbage and feces was determined by burning a known amonut of sample in the Oxygen Bomb Calorimeter.

6. Items Investigated

a. Chemical composition

(1) Chemical composition of green materials
(2) Effect of stage of maturity on chemical composition
(3) Location difference in chemical composition
(4) Family difference in content of nutrients
(5) Burning effect on chemical composition
(6) Relationship between crude protein content and crude fiber content.

b. Digestibility and digestible nutrients of native herbages.

(1) Digestion coefficient and digestible nutrients
(2) Effect of stage maturity on nutrients digestibility
(3) Digestibility difference between green materials and dried materials(hay)
(4) Computation for the content of DCP, TDN and DE
(5) Relationship between DDM and TDN or DE

c. Effect of fertilizer application on chemical composition and digestibility of native herbage plants.

(1) Chemical Composition
(2) Digestibility

IV. Results and Discussion

1. Chemical Composition of Native Herbage Plants

a. chemical composition of green materials

Eleven different species of herbage plants sampled in July and August were collected from Yongin and Suwon areas in 1968 and thirty different species of herbage plants, sampled in June, August and October,

were collected from 11 different locations in Korea. Chemical composition, Ca and P content of those samples analyzed are presented in Table 2.

Table 2. Chemical composition of some native herbage plants(green basis, %)

Year	Family	Species	Moisture %	C. Prot. %	C. Fat %	C. Fiber %	C. Ash %	NFE %	Ca %	P %	Remark
1968	Grass:	*Miscanthus purpurascens*	60.42	2.15	0.63	13.22	2.00	21.60	0.11	0.04	Yongin
		Eragrostis ferruginea	57.83	3.13	1.06	13.60	2.31	22.07	0.12	0.07	"
		Phragmites prosturatus	57.09	5.18	1.12	12.42	5.68	18.53	0.11	0.07	"
		Calamagrostis arundinacea	64.92	2.24	0.69	12.46	1.93	17.78	0.19	0.03	"
		Agropyrum semicostum	65.58	1.76	0.57	12.30	1.60	18.18	0.12	0.03	"
		Digitaria sanguinalis	80.17	2.59	0.56	5.70	2.25	8.73	0.06	0.06	"
		Zoysia japonica	66.50	2.93	0.25	9.98	3.39	16.95	0.12	0.07	Suwon
		Mean	64.64	2.85	0.70	11.38	2.74	17.69	0.12	0.05	
	Legume:	*Lespedeza spp.*	47.33	5.54	2.38	16.94	1.40	26.43	0.29	0.08	Yongin
		Pueraria thunbergiana	55.15	5.94	1.20	11.31	2.85	23.54	0.62	0.06	"
		Securinega subfruticosa	59.17	3.86	1.26	12.35	2.33	21.04	0.59	0.03	"
		Mean	53.88	5.11	1.61	13.53	2.19	23.67	0.50	0.06	"
	Shrub:	*Robinia pseudo acacia*	64.91	7.92	1.04	6.27	2.21	17.65	0.40	0.07	Suwon
		Salix glandulosa	54.33	5.57	1.55	11.38	2.51	24.67	0.51	0.07	Yongin
		Quercus dentata	57.33	7.08	1.37	11.96	1.90	30.36	0.40	0.06	Yongin
		Betula platyphylla	55.54	8.45	1.32	12.23	2.27	20.20	0.55	0.05	"
		Mean	58.03	7.26	1.32	10.46	2.22	23.22	0.46	0.06	
	Others:	Mixed Grasses (1)	74.75	2.56	0.34	7.41	2.99	11.96	0.14	0.08	Paddy
		Mixed Grasses (2)	55.08	3.07	0.94	14.21	2.37	24.33	0.15	0.04	Hill
		Mean	64.92	2.82	0.64	10.81	2.68	18.15	0.15	0.06	
1969	Grass:	*Arundinella hirta*	62.67	1.91	0.47	13.95	1.69	19.32	0.06	0.03	Kwangsan
			62.33	2.20	0.61	14.31	1.83	18.71	0.10	0.04	Jinju
			60.65	2.02	0.42	14.20	2.01	20.71	0.08	0.05	Kueje
			72.00	2.43	0.44	9.33	1.46	14.34	0.10	0.04	Jirisan
			58.50	1.77	0.42	16.22	1.86	21.23	0.11	0.06	Jirisan
			62.00	2.74	0.68	13.74	1.91	18.94	0.07	0.05	Yiri
			41.50	2.52	0.51	24.85	1.90	28.74	0.12	0.04	Daekwannyung
			58.33	3.00	0.64	14.96	2.75	20.32	0.17	0.07	Andong
			56.84	1.49	0.39	16.44	1.91	22.92	0.12	0.22	Yongin
			59.32	2.02	0.45	16.05	2.17	20.00	0.09	0.08	Hwasan
		Mean	59.41	2.21	0.50	15.40	1.95	20.52	0.10	0.07	
		Phragmites prosturatus	62.33	5.16	0.70	12.88	3.28	15.66	0.06	0.06	Kwangsan
			62.33	5.49	0.91	12.64	2.52	16.09	0.09	0.06	Jinju
			65.00	4.40	0.88	12.03	2.76	14.95	0.99	0.06	Kueje
			61.00	7.50	0.12	11.90	4.68	14.80	0.99	0.99	Jirisan
			57.50	5.27	0.83	12.79	5.70	17.93	0.08	0.04	Jirisan
			53.67	6.47	0.94	13.72	4.59	20.62	0.16	0.08	Andong
			67.73	5.12	0.68	8.83	4.60	13.05	0.06	0.05	Yongin
		Mean	61.36	5.63	0.72	12.11	4.02	16.15	0.09	0.06	
		Themeda japonica	57.33	2.80	0.74	15.96	2.23	20.95	0.08	0.05	Kwangsan
			60.00	2.41	0.65	15.65	2.44	18.86	0.09	0.04	Jinju
			59.83	1.03	0.62	15.77	2.32	20.42	0.06	0.04	Kueje

Year	Family	Species	Moisture	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE	Ca	P	Remarks
			%	%	%	%	%	%	%	%	
			54.00	2.31	0.38	16.99	3.59	22.74	0.09	0.06	Jeju
			66.00	1.64	0.42	13.83	1.78	16.33	0.08	0.33	Jirisan
			68.00	2.03	0.25	11.88	1.86	15.98	0.07	0.03	Yiri
			64.46	2.76	0.83	8.59	5.47	17.88	0.37	0.05	Daekwannyung
			61.67	1.54	0.39	14.14	2.03	20.24	0.10	0.05	Andong
			48.73	1.86	1.07	20.58	3.06	24.70	0.09	0.02	Yongin
			54.10	3.38	0.56	18.12	2.35	21.50	0.30	0.05	Hwasan
	Mean		59.41	2.18	0.59	15.15	2.71	19.96	0.13	0.04	
		Miscanthus purpurascens	57.00	2.35	0.61	15.85	2.10	22.08	0.06	0.04	Kwangsan
			60.00	2.79	0.57	15.66	2.17	18.81	0.10	0.05	Jinju
			66.33	2.25	0.37	12.20	1.96	16.89	0.06	0.05	Kueje
			60.50	1.86	0.52	15.75	2.22	19.16	0.07	0.05	Jeju
			60.00	3.33	1.02	14.20	2.11	19.34	0.10	0.05	Jirisan
			58.00	2.22	0.78	16.84	2.23	19.93	0.09	0.04	Jirisan
			60.00	7.23	0.22	15.42	2.07	15.05	0.11	0.06	Yiri
			48.79	2.56	0.59	21.15	2.62	24.29	0.11	0.04	Daekwannyung
			57.33	3.29	0.46	15.87	2.24	20.80	0.16	0.07	Andong
			56.13	1.64	0.53	16.93	2.19	22.58	0.12	0.03	Yongin
			61.77	1.91	0.33	14.50	2.14	19.35	0.07	0.04	Hwasan
	Mean		58.71	2.86	0.55	15.85	2.19	19.84	0.09	0.05	
		Eragrostis ferruginea	66.67	3.45	0.94	11.95	2.08	16.91	0.09	0.10	Kwangsan
			61.17	3.64	0.80	13.06	2.67	18.68	0.10	0.10	Jinju
			63.00	3.50	0.11	14.33	2.96	16.09	0.11	0.14	Yiri
			66.00	3.32	0.52	10.91	2.45	16.78	0.09	0.09	Kueje
			63.00	4.54	1.14	11.00	2.01	18.31	0.10	0.09	Jirisan
			52.50	2.98	0.80	17.13	2.64	23.96	0.11	0.07	Jirisan
			50.00	4.30	0.70	16.39	3.69	24.94	0.14	0.16	Andong
			53.30	4.10	0.98	15.41	2.83	23.39	0.12	0.13	Yongin
			57.73	3.49	0.90	13.80	2.35	21.73	0.08	0.07	Hwasan
	Mean		59.26	3.70	0.77	13.78	2.63	20.09	0.10	0.11	
		Imperata cylindrica	64.33	2.38	0.61	13.82	1.52	17.33	0.07	0.04	Kwangsan
			66.00	2.70	0.84	14.12	1.64	14.71	0.07	0.06	Jinju
			64.20	2.44	0.64	13.54	1.73	17.44	0.09	0.05	Kueje
			58.17	2.51	0.69	16.54	1.98	20.12	0.10	0.05	Jeju
			68.50	1.59	0.69	10.35	1.38	17.60	0.08	0.03	Jirisan
	Mean		64.24	2.32	0.68	13.67	1.65	17.44	0.08	0.05	
		Zijania caduciflora	73.00	2.98	0.69	8.65	3.09	11.59	0.05	0.04	Kwangsan
			67.00	4.13	0.81	10.98	3.54	13.55	0.08	0.05	Jinju
			50.00	6.78	0.54	17.52	7.02	18.16	0.11	0.08	Yiri
	Mean		63.00	4.63	0.67	12.38	4.55	14.43	0.08	0.06	
		Paspalum thunbergii	74.87	1.94	0.46	8.62	1.79	12.33	0.06	0.04	Kwangsan
			80.00	1.75	0.42	7.73	1.51	8.60	0.06	0.03	Jirisan
			70.00	4.31	0.91	8.63	2.69	13.45	0.06	0.05	Jiri
	Mean		74.99	1.77	0.60	8.33	2.00	11.46	0.06	0.04	
		Cymbopogon goeringii	63.33	2.26	0.83	13.33	1.83	18.42	0.08	0.03	Kwangsan
			55.67	2.80	1.81	16.43	2.43	20.87	0.61	0.05	Jinju

Year	Family	Species	Moisture	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE	Ca	P	Remarks
			%	%	%	%	%	%	%	%	
			68.00	2.19	1.04	10.94	1.82	16.01	0.07	0.07	Kueje
			52.73	1.88	1.40	17.78	2.33	23.89	0.09	0.07	Jeju
			58.00	2.45	1.44	15.69	1.97	20.46	0.09	0.05	Jirisan
			60.00	2.70	0.14	14.74	2.42	19.99	0.10	1.05	Yiri
			56.70	2.38	1.43	16.31	2.12	21.05	0.11	0.02	Yongin
			50.40	3.12	1.65	19.38	2.74	22.74	0.08	0.05	Hwasan
	Mean		58.10	2.47	1.22	15.58	2.21	20.43	0.15	0.05	
		Eulia speciosa	61.33	1.77	0.67	15.66	1.77	18.80	0.08	0.03	Kwangsan
			55.75	2.07	0.71	17.69	2.32	21.47	0.09	0.04	Jinju
			62.50	1.94	0.55	14.64	1.88	18.48	0.07	0.03	Kueje
			60.00	2.69	0.28	15.44	2.64	18.94	0.04	0.05	Yiri
			54.33	3.31	0.78	14.97	2.90	23.71	0.20	0.07	Andong
	Mean		58.78	2.36	0.60	15.68	2 30	20.28	0.10	0.04	
		Digitaria sanguinalis	80.00	1.85	0.28	6.71	1.54	9.63	0.05	0.03	Kwangsan
			77.50	3.06	0.60	6.50	2.46	9.89	0.07	0.09	Jinju
			77.70	2.28	0.35	7.15	2.53	9.93	0.08	0.06	Kueje
			80.00	1.61	0.54	6.58	1.69	9.59	0.07	0.07	Jirisan
			80.00	1.50	0.24	6.90	1.98	9.38	0.03	0.05	Yiri
			66.67	3.74	0.67	9.82	3.73	15.37	0.11	0.12	Andong
	Mean		76.98	2.34	0.45	7.28	2.32	10.63	0.07	0.07	
		Andropogon micranthus	54.63	1.79	0.43	16.06	2.96	24.14	0.14	0.04	Kwangsan
			58.33	2.47	0.65	14.79	3.32	20.44	0.16	0.04	Jinju
			44.80	2.07	0.57	19.29	4.76	28.51	0.10	0.06	Kueje
			57.50	2.12	0.32	15.33	4.00	20.72	0.13	0.05	Jeju
			60.00	2.68	0.70	13.82	3.07	19.73	0.14	0.08	Andong
	Mean		55.05	2.23	0.53	15.86	3.62	22.71	0.13	0.05	
		Calamagrostis arundinacca	61.67	3.20	0.80	14.90	3.41	16.03	0.10	0.04	Jinju
			52.90	3.23	0.82	19.55	3.86	19.65	0.10	0.07	Kueje
			70.00	3.65	0.49	10.72	2.22	12.92	0.08	0.05	Jirisan
			64.50	2.60	0.69	14.11	3.48	14.64	0.06	0.03	Jirisan
			62.50	2.80	0.57	14.12	2.25	17.78	0.14	0.07	Andong
			58.06	2.91	0.95	15.62	3.39	19.05	0.10	0.03	Yongin
			61.87	3.87	0.87	13.90	3.88	15.62	0.11	0.08	Hwasan
	Mean		61.64	3.18	0.74	14.70	3.21	16.54	0.11	0.05	
		Eccoilopus cotulifer	60.33	2.38	0.44	14.75	2.10	20.00	0.20	0.03	Jinju
			62.33	2.40	0.46	14.40	2.07	18.34	0.11	0.04	Kueje
			69.00	3.34	0.58	10.30	2.09	14.69	0.13	0.05	Jirisan
			70.00	2.06	0.62	11.96	1.64	13.71	0.10	0.36	Jirisan
			45.97	4.14	0.43	21.44	2.70	25.32	0.23	0.04	Dackwannyung
			61.67	2.97	0.63	13.45	2.61	18.68	0.21	0.07	Andong
	Mean		61.55	2.88	0.53	14.38	2.20	18.46	0.16	0.06	
		Pennisetum japonica	64.67	2.73	0.55	8.48	2.22	11.36	0.09	0.07	Jinju
			68.00	1.74	0.58	12.06	2.94	14.68	0.08	0.09	Kueje
			75.00	3.31	0.65	7.71	2.21	11.12	0.08	0.05	Jirisan
			73.50	1.79	0.37	9.95	1.96	12.46	0.09	0.04	Jirisan

Year	Family	Species	Moisture	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE	Ca	P	Remarks
			%	%	%	%	%	%	%	%	
			55.00	2.95	0.76	17.58	3.38	20.34	0.14	0.09	Andong
		Mean	69.23	2.51	0.88	11.56	2.54	13.99	0.10	0.07	
		Festuca ovina	51.08	3.94	1.05	17.38	3.17	23.37	0.15	0.04	Daekwannyung
			50.25	3.28	1.20	17.26	2.72	25.29	0.12	0.04	Yongin
			54.72	4.32	1.51	16.02	2.57	20.86	0.47	0.05	Hwasan
		Mean	52.02	3.85	1.25	16.89	2.82	23.17	0.25	0.04	
		Zoysia japonica	60.00	3.32	0.70	12.38	2.67	20.93	0.09	0.07	Kueje
			47.37	3.47	0.96	17.96	3.70	26.54	0.16	0.14	Yongin
			41.26	5.04	0.75	19.09	3.81	30.05	0.15	0.14	Hwasan
		Mean	49.54	3.94	0.80	16.48	3.39	25.84	0.13	0.12	
		Setaraia viridis	72.73	1.90	0.49	8.86	2.38	13.64	0.08	0.09	Kueju
			77.09	1.91	0.58	8.83	3.02	8.66	0.06	0.11	Yiri
			62.33	5.16	1.00	12.03	3.62	15.86	0.17	0.12	Andong
		Mean	70.69	2.99	0.69	9.91	9.01	12.72	0.10	0.11	
		Beckmannia crucaeformis	70.60	3.68	0.54	10.22	3.07	12.50	0.14	0.09	Kueje
			80.00	4.02	0.81	5.43	1.95	7.79	0.07	0.10	Andong
		Mean	75.00	3.90	0.68	7.83	2.51	10.15	0.11	0.10	
		Miscanthus sinensis	62.70	2.62	0.22	14.39	2.06	18.01	0.09	0.06	Jeju
	Legume:	*Lespedeza cuneata*	57.67	5.72	0.90	17.03	2.14	19.87	0.26	0.07	Kwangsan
			61.50	5.23	0.90	13.65	2.05	16.69	0.43	0.06	Jinju
			63.20	5.06	0.57	12.57	1.90	16.70	0.35	0.07	Kueje
			53.33	5.97	0.97	12.12	2.33	20.26	0.57	0.07	Jeju
			62.00	5.90	0.83	10.57	1.95	18.75	0.36	0.08	Jirisan
			60.00	5.11	0.77	14.52	1.47	18.13	0.34	0.05	Jirisan
			50.00	6.50	0.56	18.90	1.95	22.09	0.50	0.07	Yiri
			55.00	5.55	1.14	12.00	2.59	23.73	0.54	0.07	Andong
			60.70	5.49	0.63	12.30	3.14	17.75	0.34	0.08	Hwasan
		Mean	58.16	5.50	0.81	13.74	2.17	19.33	0.41	0.07	
		Lespedeza cytissides	60.00	6.46	1.42	7.92	1.33	22.81	0.20	0.04	Kwangsan
			63.00	5.65	0.69	11.16	4.31	15.18	0.27	0.04	Yiri
			54.00	6.21	1.81	9.37	3.38	25.23	1.43	0.06	Andong
		Mean	59.00	6.11	1.31	9.48	3.02	21.07	0.67	0.05	
		Lespedeza striata	61.00	6.01	1.17	13.41	2.14	16.29	0.34	0.10	Kwangsan
			60.67	5.95	1.19	14.56	2.26	15.38	0.29	0.13	Jinju
			53.65	7.18	0.71	18.07	4.86	15.54	0.35	0.12	Kueje
			65.00	5.59	0.97	10.28	2.15	16.02	0.34	0.38	Yiri
			76.50	4.64	0.50	7.63	1.48	9.26	0.25	0.06	Daekwannyung
			56.67	6.52	0.97	13.15	2.59	20.10	0.46	0.08	Andong
			48.78	8.20	2.69	16.32	3.22	20.81	0.31	0.11	Hwasan
		Mean	58.90	6.30	1.17	13.35	2.67	16.20	0.33	0.10	
		Pueraria thunbergiana	70.50	4.76	0.80	7.54	2.67	11.74	0.27	0.04	Jinju
			72.17	5.52	0.63	7.18	2.29	12.22	0.47	0.05	Kueje
			75.00	6.85	0.77	5.84	2.10	9.44	0.39	0.07	Jirisan
			72.00	3.98	0.65	9.46	1.88	12.04	0.44	0.04	Jirisan
			59.33	5.18	0.76	12.61	3.55	18.57	0.98	0.09	Andong

Year	Family	Species	Moisture	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE	Ca	P	Remarks
			%	%	%	%	%	%	%	%	
			66.80	4.20	0.75	11.97	1.87	14.40	0.43	0.09	Yongin
		Mean	69.63	5.08	0.73	9.10	2.39	13.07	0.50	0.08	
		Lespedeza spp.	63.83	6.28	0.87	11.84	1.45	15.74	0.33	0.08	Jeju
			69.00	3.62	1.10	10.27	1.16	14.86	0.27	0.08	Jirisan
			60.00	5.77	1.31	14.13	1.52	17.27	0.30	0.05	Yiri
			51.67	6.13	2.28	14.63	2.49	22.80	0.72	0.07	Andong
			58.66	5.01	1.52	11.77	1.51	21.53	0.45	0.03	Yongin
			55.22	5.52	1.14	18.47	2.16	17.50	0.46	0.07	Hwasan
		Mean	59.73	5.39	1.37	13.52	1.72	28.28	0.42	0.06	
		Amorpha fructicosa	63.70	4.46	0.97	11.17	1.49	18.21	0.54	0.03	Yongin
			66.47	5.00	0.98	10.01	1.56	15.97	0.26	0.05	Hwasan
		Mean	65.99	4.73	0.98	10.59	1.53	17.09	0.40	0.04	
	Shrubs:	*Robinia pseudo acacia*	76.70	4.37	0.81	4.37	1.18	12.59	0.32	0.04	Kueje
			61.67	9.48	1.12	7.32	2.48	17.93	0.65	0.09	Andong
		Mean	69.19	6.93	0.97	5.85	1.83	15.26	0.49	0.07	
		Betula platyphylla	64.18	6.43	1.14	9.26	1.34	17.66	0.32	0.05	Yongin
		Mean	64.18	6.43	1.14	9.26	1.34	17.66	0.32	0.05	
	Carduaceae:	*Artemisia asiatica*	70.00	3.45	0.86	10.21	2.32	13.17	0.20	0.07	Jirisan
			78.13	4.55	0.51	5.41	2.12	9.28	0.19	0.07	Daekwannyung
			66.44	4.96	1.24	8.26	2.68	16.41	0.29	0.09	Yongin
			72.95	4.43	1.32	6.05	2.42	12.83	0.22	0.08	Hwasan
		Mean	71.88	4.35	0.98	7.48	2.38	12.92	0.23	0.08	
		Artemisia japonica	59.33	3.66	1.13	13.09	2.61	20.18	0.43	0.09	Jeju
			69.89	2.66	0.95	7.63	2.37	16.49	0.29	0.04	Yongin
			68.59	2.10	0.92	7.50	2.70	18.21	0.36	0.04	Hwasan
		Mean	65.94	2.81	1.00	9.46	2.56	18.29	0.36	0.06	

(1) Moisture content

Digitaria sanguinalis had the highest moisture content of 80.17% in 1968 and of 76.98% in 1969 among the grass species. Other annuals such as *Beckmannia erucaeformis*, *Paspalum thunbergii* and *Setaria viridis* had relatively higher moisture content than perennials such as *Arundinella hirta*, *Themeda japonica* *Miscanthus purpurascens* and *Eulia speciosa*.

Pueraria thunbergiana was the only species which has relatively high moisture content in Legumes. *Artemisia asiatica* showed higher water content than *Artemisia japonica* in Carduaceae species.

Mixed grasses collected from paddy areas showed higher water content than those collected from hill sides. It appeared from the results that soil conditions and botanical composition of mixed grasses might have affected the difference in moisture content.

(2) Crude protein content

Leguminous species and shrubs showed higher crude protein content than grass species in general. *Arundinella hirta* had a relatively lower protein content of 2.21% than other species such as *Phragmites prosturatus* (5.63%), *Beckmannia erucaeformis* (3.90%), *Paspalum thunbergii* (2.67%), *Digitaria sanguinalis* (2.34%), *Zijania caduciflora* (4.63%), *Eragrostis ferruginea* (3.7%) and *Setaria viridis* (2.99%).

All the legumes tested had higher crude protein content than that of grass species and shrubs, *i.e.* *Lespedeza striata* (6.3%), *Lespedeza cytissides* (6.11%), *Lespedeza cuneata* (5.5%), *Lespedeza spp.* (5.39%), and *Pueraria thunbergiana* (5.08%).

Robinia pseudo acacia had the highest protein content of 6.93% among the herbage plants tested. *Artemisia asiatica* (4.35%) showed higher protein content than *Artemisia japonica* (2.81%).

(3) Crude fat content

Crude fat content was the lowest portion in proximate composition of the native herbage plants.

Eragrostis ferruginea (0.77%), *Phragmites prosturatus* (0.72%), *Cymbopogon goeringii* (1.22%) and *Festuca ovina* (1.25%) showed relatively high crude fat content in grass species. Crude fat contents of legumes (1.61%) and shrubs (1.32%) were higher than that of grass species (0.70%) when they were averaged for the data obtained in 1968. The crude fat content of *Lespedeza spp.* (1.37%), *Lespedeza cytissides* (1.31%) and *Lespedeza striata* (1.17%) in legumes was known to be highest among all native species. There were no differences in crude fat content among the *carduaceae* species tested.

(4) Crude fiber content

Of the grass species the crude fiber contenst of *Digitaria sanguinalis* (5.70%, 7.23%) and *Phragmites prosturatus* (12.42%, 12.11%) determined in 1968 and 1969 was lower than other grass species. In 1969, *Beckmannia erucaeformis* (7.83%), *Setaria viridis* (9.91%) and *Paspalum thunbergii*(8.33%) also showed relatively lower crude fiber content than other grass species.

Of the legumenous species *Pueraria thunbergiana* was found to have the lowest fiber content. In general the crude fiber contents of legumes appeared to be lower than those of grasses.

Robinia pseudo acacia had the lowest fiber content of 17.87% in 1968 and of 18.98% in 1969 on dry matter basis among the native herbage plants analyzed. Mixed grasses collected from paddy area showed considerably lower crude fiber content when compared to that of mixed grasses collected from hill sides (7.41% vs. 14.21%). Data obtained in 1969 was found to be higher in crude fiber content than in 1968 due to inclusion of materials collected in October in the former. Other possible factors might have been due to year difference, climatic conditions and different locations of collection.

(5) Content of Ca and P

Although there were no big differences in Ca content among species within families, there appeared to be slight differences between families. In general, shrub and legume family showed higher content of Ca tnan that of the grass family. The results showed no practical difference in P content of the native herbage plants analyzed.

No direct comparison was possible with the limited data published on this matter. Some of the results obtained by the Livestock Experiment Station (1968)[2] showed a similar trend in chemical composition of native grasses. Comparison with Morrison could not be made with the results of the present study. Content of Ca and P were very much similar to those obtained by Chiang (1967, 1968)[9,10].

b. Effect of stage of maturity on chemical composition.

(1) Individual species

In 1968, herbage samples were collected from Songhwan, Jeju and Yongin area monthly(May to Oct), and in 1969, herbage samples were also collected in June(preblooming stage), August(blooming stage) and October(post blooming stage) from 11 different locations throughout the nation. The results are presented in Table 3.

Table 3. Effect of stage of maturity on chemical composition of some native herbage plants(Dry matter basis, %)

Year	Family	Species	Stage of mat.	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE	Ca	P	Remarks
				%	%	%	%	%	%	%	
1968	Grass:	*Arundinella hirta*	June	7.05	2.49	33.18	4.19	53.09	—	—	
			July	6.47	3.17	34.69	4.73	50.94	—	—	
			Aug.	5.94	2.76	34.84	4.07	52.29	—	—	
			Sep.	5.64	2.00	34.55	9.12	53.69	—	—	
			Oct.	4.73	1.42	34.69	1.67	57.49	—	—	
			Mean	5.97	2.37	34.39	3.76	53.50	—	—	
		Themeda japonica	June	8.51	3.02	35.25	4.97	48.52	—	—	
			July	6.96	3.00	35.17	5.76	49.11	—	—	
			Aug.	6.14	3.06	32.84	6.28	51.68	—	—	
			Sep.	6.07	1.57	38.11	4.66	49.59	—	—	
			Oct.	5.95	1.97	40.58	4.82	46.68	—	—	
			Mean	6.73	2.52	36.39	26.49	49.12	—	—	
		Miscanthus purpurascens	June	6.71	1.82	35.03	4.49	51.96	—	—	
			July	6.02	3.02	36.92	4.04	49.98	—	—	
			Aug.	5.87	2.13	33.23	9.50	54.68	—	—	
			Sep.	5.68	1.75	34.43	4.63	53.53	—	—	
			Oct.	5.85	1.49	37.07	6.47	49.15	—	—	
			Mean	6.03	2.04	35.34	4.83	51.86	—	—	
		Eragrostis ferruginea	June	9.03	2.71	34.90	9.31	49.05	—	—	
			July	7.50	3.62	37.21	4.65	74.02	—	—	
			Aug.	7.39	3.17	37.58	4.74	47.12	—	—	
			Sep.	8.44	2.02	38.97	4.01	46.59	—	—	
			Oct.	7.36	2.43	39.54	4.57	46.10	—	—	
			Mean	7.94	2.79	37.64	4.46	47.17	—	—	
		Imperata cylindrica	May	6.67	1.55	31.72	4.73	55.34	—	—	
			June	6.52	1.58	34.20	4.36	53.33	—	—	
			July	6.53	2.93	35.35	4.39	50.84	—	—	
			Aug.	6.48	2.41	33.78	3.75	53.62	—	—	
			Sep.	7.17	2.04	35.26	5.96	49.67	—	—	
			Oct.	7.62	2.27	38.54	4.57	46.70	—	—	
			Mean	6.83	2.13	34.81	4.63	51.58	—	—	
		Paspalum thunbergii	July	12.37	4.78	29.42	8.35	45.08	—	—	
			Aug.	8.97	3.26	36.13	5.97	45.67	—	—	
			Sep.	8.37	1.76	36.17	6.56	47.14	—	—	
			Oct.	7.93	1.52	36.80	5.64	48.11	—	—	
			Mean	9.41	2.83	34.63	6.63	46.50	—	—	
		Cymbopogon goeringii	May	7.23	3.29	27.43	6.87	55.18	—	—	
			June	7.78	2.93	33.13	4.18	51.84	—	—	
			July	6.69	4.51	31.66	4.95	52.18	—	—	
			Aug.	5.40	4.08	33.40	4.76	51.85	—	—	
			Sept.	5.34	3.66	35.93	3.81	50.57	—	—	
			Oct.	4.93	3.35	36.85	4.66	50.21	—	—	

Year	Family	Species	Stage of mat.	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE	Ca	P	Remarks
				%	%	%	%	%	%	%	
			Mean	6.23	3.64	33.07	4.87	51.97	—	—	
		Digitaria sanguinalis	July	19.07	5.08	20.38	10.86	44.41	—	—	
			Aug.	12.64	4.37	29.77	9.09	44.13	—	—	
			Sept.	9.80	2.18	35.71	7.52	44.79	—	—	
			Oct.	6.25	2.53	40.01	6.89	44.32	—	—	
			Mean	11.94	3.54	31.47	8.59	44.41	—	—	
		Agropyrum semicostum	June	11.48	3.08	33.36	5.66	46.42	—	—	
			July	7.02	2.71	36.46	5.54	48.27	—	—	
			Mean	9.25	2.90	34.91	5.60	47.35	—	—	
		Zoysia japonica	June	10.03	2.58	31.60	3.79	52.00	—	—	
			July	9.17	3.55	31.56	5.11	50.61	—	—	
			Aug.	7.41	3.97	33.76	5.07	49.79	—	—	
			Sept.	7.24	5.16	33.65	5.03	48.92	—	—	
			Oct.	6.48	1.49	33.11	5.16	53.76	—	—	
			Mean	8.07	3.35	32.74	4.83	51.02	—	—	
		Setaria viridis	July	9.25	3.17	35.64	5.98	45.96	—	—	
			Aug.	6.31	2.64	36.77	7.11	47.17	—	—	
			Sept.	8.67	1.51	39.65	7.50	42.67	—	—	
			Oct.	5.76	2.16	36.54	9.52	46.02	—	—	
			Mean	7.50	2.37	37.15	7.53	45.46	—	—	
		Phragmites prosturatus	Aug.	13.37	2.93	29.52	12.24	41.94	0.23	0.15	
			Sept.	10.27	2.14	28.17	14.57	44.85	0.29	0.12	
			Mean	11.82	2.54	28.85	13.41	43.40	0.26	0.14	
		Calamagrostis arundinacea	Aug.	6.52	1.72	35.35	5.35	51.07	0.55	0.08	
			Sept.	6.21	2.22	35.67	5.64	50.27	0.52	0.08	
			Mean	6.37	1.97	35.51	5.50	50.67	0.54	0.08	
	Legume:	*Lespedeza cuneata*	June	14.77	2.98	26.54	4.17	51.54	—	—	
			July	13.52	3.28	31.97	4.54	46.68	—	—	
			Aug.	13.11	2.62	33.81	3.92	46.55	—	—	
			Sept.	12.94	2.09	35.33	3.66	45.99	—	—	
			Oct.	10.15	3.60	37.56	4.47	44.22	—	—	
			Mean	12.90	2.91	33.04	4.15	47.00	—	—	
		Lespedeza striata	July	17.53	5.31	25.09	6.35	45.72	—	—	
			Aug.	17.33	4.00	28.44	6.58	43.65	—	—	
			Sept.	15.21	3.11	32.30	4.21	45.17	—	—	
			Oct.	7.42	2.52	37.37	4.00	48.69	—	—	
			Mean	14.37	3.74	30.80	5.29	45.81	—	—	
		Pueraria thunbergiana	May	19.86	0.75	14.99	8.36	56.03	—	—	
			June	21.30	3.25	26.76	7.00	41.69	—	—	
			July	18.64	3.67	29.58	7.97	40.15	—	—	
			Aug.	16.73	4.17	26.90	4.12	48.09	—	—	
			Sept.	19.58	2.76	23.39	7.11	47.16	—	—	

Year	Family	Species	Stage of mat.	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE	Ca	P	Remarks
				%	%	%	%	M	%	%	
			Oct.	16.13	3.69	23.51	9.13	47.54	—	—	
			Mean	18.71	3.05	24.19	7.28	46.78	—	—	
		Cassia nomame	July	18.48	5.38	20.38	5.41	50.39	—	—	
			Aug.	16.23	5.59	26.00	3.87	48.31	—	—	
			Sept.	13.92	4.09	29.68	2.85	49.45	—	—	
			Oct.	12.44	5.11	39.74	3.05	39.66	—	—	
			Mean	15.27	5.04	28.95	3.80	46.95	—	—	
		Dunbaria villosa	June	15.14	3.23	27.94	4.09	49.60	—	—	
			July	17.52	4.70	30.08	4.40	43.29	—	—	
			Aug.	16.17	4.43	24.75	4.34	50.32	—	—	
			Sept.	13.78	4.38	21.81	4.33	55.70	—	—	
			Mean	15.65	4.19	26.15	4.29	49.73	—	—	
		Indigofera koreana	June	18.16	4.26	24.55	5.27	47.76	—	—	
			July	16.24	4.34	23.96	6.23	49.24	—	—	
			Aug.	18.51	3.95	15.84	6.51	55.18	—	—	
			Sept.	13.51	4.58	23.74	4.15	54.02	—	—	
			Mean	16.61	4.28	22.02	5.54	51.55	—	—	
		Amorpha fructicosa	June	28.28	3.74	13.14	4.37	50.47	—	—	
			July	24.03	6.46	17.14	4.84	47.53	—	—	
			Aug.	25.43	6.84	17.82	4.64	45.26	—	—	
			Sept.	21.90	5.30	17.52	3.84	51.44	—	—	
			Oct.	19.96	4.29	16.94	4.78	54.03	—	—	
			Mean	23.92	5.33	16.51	4.49	49.75	—	—	
		Lespedeza bicolor	June	19.93	3.57	23.06	4.57	48.87	—	—	
			July	19.65	5.25	25.50	4.86	44.74	—	—	
			Aug.	16.08	4.98	27.35	4.72	46.87	—	—	
			Sept.	16.20	2.53	25.29	4.79	51.19	—	—	
			Oct.	13.93	4.87	29.98	4.21	47.01	—	—	
			Mean	17.16	4.24	26.24	4.63	47.74	—	—	
	Shrub:	*Robinia pseudo acacia*	June	31.20	3.74	9.14	5.78	50.14		—	
			July	31.79	6.30	11.46	5.68	44.70		—	
			Aug.	27.36	6.00	15.02	4.81	46.81	—	—	
			Sept.	27.59	5.28	16.24	4.25	46.64	—	—	
			Oct.	17.54	4.27	13.70	4.32	60.17	—	—	
			Mean	27.10	5.12	13.11	4.97	49.69	—	—	
		Betula platyphylla	Aug.	20.00	3.33	23.22	5.74	47.70	1.17	0.08	
			Sept.	17.85	2.52	32.53	4.34	41.75	1.31	0.12	
			Mean	18.93	2.93	27.87	5.04	45.23	1.24	0.10	
			June	15.58	3.65	15.05	9.97	55.75	—	—	
	Carduaceae:	*Artemisia asiatica*	July	11.73	4.12	20.56	8.23	55.36	—	—	
			Aug.	13.93	5.08	24.68	8.43	47.88	—	—	
			Sept.	12.81	5.27	33.51	5.92	42.49	—	—	
			Oct.	9.02	3.98	33.68	4.55	48.77	—	—	

Year	Family	Species	Stage of mat.	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE	Ca	P	Remarks
				%	%	%	%	%	%	%	
			Mean	12.61	4.42	25.50	7.42	50.05	—	—	
		Artemisia japonica	June	9.21	2.07	23.97	6.88	57.88	—	—	
			July	8.03	2.74	31.42	6.07	52.02	—	—	
			Aug.	7.00	2.42	25.22	5.67	59.68	—	—	
			Sept.	7.60	2.00	28.50	9.35	57.55	—	—	
			Mean	7.96	2.24	27.28	5.74	56.78	—	—	
1969	Grass:	*Arundinella hirta*	June	7.73	1.68	34.26	5.61	50.43	0.30	0.14	
			Aug.	6.36	1.26	9.36	5.51	47.63	0.24	0.15	
			Oct.	5.14	1.04	38.52	5.38	49.94	0.22	0.10	
			Mean	6.41	1.33	37.38	5.50	49.33	0.25	0.13	
		Phragmites purpurascens	June	16.53	2.45	30.89	10.10	41.22	0.28	0.19	
			Aug.	14.45	2.06	33.27	10.30	39.99	0.21	0.15	
			Oct.	12.77	1.63	30.63	11.07	43.90	0.19	0.11	
			Mean	14.58	2.05	31.60	10.49	41.70	0.23	0.15	
		Themeda japonica	June	66.90	1.73	32.84	7.87	49.74	0.45	0.14	
			Aug.	6.79	1.40	38.71	6.64	46.45	0.30	0.14	
			Oct.	5.36	1.48	37.96	6.72	48.50	0.26	0.10	
			Mean	6.35	1.54	36.50	7.08	48.23	0.34	0.13	
		Miscanthus purpurascens	June	8.31	2.00	34.56	5.87	49.26	0.25	0.15	
			Aug.	7.81	1.51	39.62	5.71	45.36	0.25	0.14	
			Oct.	5.30	0.83	38.70	5.60	49.85	0.21	0.11	
			Mean	7.14	1.45	37.63	5.73	48.16	0.24	0.13	
		Eragrostis ferruginea	June	11.77	3.02	30.30	6.34	48.58	0.28	0.30	
			Aug.	9.85	2.09	36.74	6.81	44.50	0.24	0.28	
			Oct.	7.70	1.23	33.85	6.58	50.58	0.23	0.23	
			Mean	9.77	2.11	33.63	6.58	47.89	0.25	0.27	
		Imperata cylindrica	June	8.19	1.94	36.28	4.86	48.73	0.22	0.15	
			Aug.	6.87	1.99	38.59	4.80	47.76	0.25	0.14	
			Oct.	4.46	1.59	39.32	4.29	50.35	0.23	0.09	
			Mean	6.51	1.84	38.06	4.65	48.95	0.23	0.13	
		Zijania caduciflora	June	14.40	2.58	32.59	12.00	38.41	0.21	0.17	
			Aug.	12.47	1.37	34.57	11.45	40.14	0.23	0.15	
			Oct.	7.67	2.14	32.74	11.90	45.55	0.20	0.07	
			Mean	11.52	2.03	33.30	11.78	41.37	0.21	0.13	
		Paspalum thunbergii	June	12.49	3.39	28.52	8.14	47.47	0.29	0.22	
			Aug.	8.91	1.22	38.66	7.65	43.56	0.25	0.15	
			Oct.	7.93	1.09	35.15	7.04	50.80	0.16	0.17	
			Mean	9.11	1.90	34.11	7.61	47.28	0.23	0.18	
		Cymbopogon goeringii	June	8.87	3.48	30.54	6.67	50.44	0.32	0.16	
			Aug.	6.87	3.12	38.30	6.08	42.74	0.30	0.14	
			Oct.	5.33	2.94	37.84	5.04	48.85	0.17	0.12	
			Mean	7.02	3.18	35.56	5.94	47.34	0.26	0.14	

Yera	Family	Species	Stage of mat.	C. Prot. %	C. Fat %	C. Fiber %	C. Ash %	NFE %	Ca %	P %	Remarks
		Eulia spcciosa	June	7.34	1.87	37.88	6.45	46.47	0.25	0.16	
			Aug.	8.51	2.28	34.79	6.32	48.11	0.29	0.13	
			Oct.	5.64	1.23	39.65	5.49	48.00	0.23	0.13	
			Mean	7.16	1.79	37.44	6.09	47.53	0.26	0.14	
		Digitaria sanguinalis	June	18.36	3.37	25.79	12.48	39.99	0.39	0.45	
			Aug.	10.67	2.51	31.73	10.03	45.07	0.28	0.34	
			Oct.	9.56	1.42	32.67	10.00	46.36	0.31	0.28	
			Mean	12.86	2.43	30.06	10.84	43.81	0.33	0.36	
		Andropogon micranthus	June	9.21	1.87	32.09	8.33	48.51	0.36	0.20	
			Aug.	7.68	1.76	35.55	8.05	46.95	0.31	0.18	
			Oct.	5.29	1.08	35.01	9.15	49.47	0.29	0.12	
			Mean	7.39	1.57	34.22	8.51	48.31	0.32	0.17	
		Calamagrostis arundinacea	June	9.78	1.99	34.18	7.92	45.84	0.24	0.13	
			Aug.	10.01	2.57	38.59	9.74	39.10	0.25	0.18	
			Oct.	7.40	1.60	39.52	8.85	42.64	0.18	0.12	
			Mean	9.06	2.05	37.53	8.84	42.52	0.22	0.14	
		Eccoilopus cotulifer	June	9.21	2.53	34.45	6.39	48.86	0.39	0.19	
			Aug.	8.59	1.81	37.56	6.42	45.63	0.44	0.19	
			Oct.	7.46	1.00	37.99	6.24	47.29	0.39	0.14	
			Mean	8.43	1.78	36.67	6.35	47.26	0.41	0.17	
		Pennisetum japonica	June	13.96	2.88	30.88	9.90	42.38	0.33	0.32	
			Aug.	9.48	1.94	36.47	8.19	43.93	0.30	0.26	
			Oct.	7.36	1.26	36.03	8.89	45.48	0.31	0.22	
			Mean	10.27	2.03	34.79	8.99	43.93	0.31	0.27	
		Agropyrum semicostum	June	13.86	2.47	30.56	7.46	45.67	0.33	0.25	
			Aug.	—	—	—	—	—	—	—	
			Oct.	—	—	—			—	—	
			Mean	13.86	2.47	30.56	7.46	45.67	0.33	0.25	
		Festuca ovina	June	7.54	3.22	29.69	5.17	54.46	0.25	0.08	
			Aug.	8.09	2.61	36.69	5.82	46.80	1.08	0.10	
			Oct.	7.77	2.75	35.53	5.56	48.39	0.19	0.10	
			Mean	7.80	2.86	33.94	5.52	49.88	0.51	0.09	
		Zoysia japonica	June	7.03	1.97	31.11	5.92	53.97	0.23	0.16	
			Aug.	9.26	1.58	34.67	5.57	48.93	0.25	0.27	
			Oct.	6.80	1.19	33.35	8.50	50.18	0.32	0.29	
			Mean	7.70	1.58	33.04	6.66	51.03	0.27	0.24	
		Setaria viridis	June	13.01	2.62	26.23	5.10	53.05	0.40	0.29	
			Aug.	10.43	2.38	35.30	11.11	40.78	0.33	0.39	
			Oct.	8.07	1.94	35.25	11.17	43.58	0.37	0.34	
			Mean	10.50	0.31	32.26	9.13	45.80	0.37	0.34	
		Beckmannia erucaeformis	June	16.18	2.92	30.61	10.00	40.30	0.40	0.37	
			Aug.	—	—	—	—	—	—	—	

Year	Family	Species	Stage of mat.	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE	Ca	P	Remarks
				%	%	%	%	%	%	%	
			Oct.	—	—	—	—	—	—	—	
			Mean	16.18	2.92	30.61	10.00	40.30	0.40	0.37	
		Miscanthus sinensis	June	6.95	1.15	38.60	5.25	48.07	0.19	0.14	
			Aug.	—	—	—	—	—	—	—	
			Oct.	—	—	—	—	—	—	—	
			Mean	6.95	1.15	38.60	5.25	48.07	0.19	0.14	
	Legume:	*Lespedeza cuneata*	June	14.47	1.83	29.84	5.77	48.11	1.00	0.17	
			Aug.	12.23	2.00	36.37	4.54	44.86	0.75	0.17	
			Oct.	11.14	2.03	39.34	5.17	42.32	1.00	0.34	
			Mean	12.61	1.95	35.18	5.16	45.10	0.92	0.24	
		Lespedeza cytissides	June	15.85	3.19	20.22	4.16	56.58	1.02	0.11	
			Aug.	14.97	2.82	26.92	9.47	45.84	2.01	0.16	
			Oct.	12.09	5.40	17.39	8.30	56.83	0.51	0.10	
			Mean	14.30	3.80	21.51	7.31	53.08	1.18	0.12	
		Lespedeza striata	June	16.25	4.26	25.78	6.90	46.81	1.06	0.26	
			Aug.	16.11	2.17	33.24	5.78	42.71	0.88	0.22	
			Oct.	14.88	2.52	38.49	6.78	37.34	0.74	0.24	
			Mean	15.75	2.98	32.50	6.49	42.29	0.89	0.24	
		Pueraria thunbergiana	June	18.21	2.17	28.18	7.82	43.63	1.74	0.21	
			Aug.	15.28	2.48	35.43	7.06	39.75	1.42	0.17	
			Oct.	13.69	2.25	30.09	8.24	45.71	1.84	0.14	
			Mean	15.73	2.30	31.23	7.71	43.03	1.67	0.17	
		Lespedeza spp.	June	17.15	3.34	28.69	3.81	47.01	0.82	0.17	
			Aug.	13.79	3.39	31.72	4.51	46.60	0.93	0.18	
			Oct.	11.23	3.13	36.70	4.43	44.52	1.94	0.12	
			Mean	14.06	3.29	32.37	4.25	46.04	1.03	0.16	
		Amorpha fructicosa	June	19.73	3.47	20.14	4.28	52.39	1.01	0.17	
			Aug.	16.32	3.85	25.90	4.59	49.35	1.45	0.15	
			Oct.	7.71	1.62	39.71	4.30	46.67	0.90	0.05	
			Mean	14.59	2.98	28.58	4.39	49.47	1.12	0.12	
		Astragalus membranaceus	June	17.12	2.76	17.97	4.88	57.27	1.06	1.04	
			Aug.	14.01	2.75	24.92	6.94	51.40	0.97	0.17	
			Oct.	7.23	1.69	34.52	4.73	51.84	1.69	0.04	
			Mean	12.79	2.40	25.80	5.52	53.50	1.24	0.12	
	Shrub:	*Robinia paeudo acacia*	June	27.04	2.98	16.40	5.44	48.14	1.72	0.26	
			Aug.	24.29	2.96	18.25	6.43	48.09	1.26	0.24	
			Oct.	19.26	3.27	20.31	5.80	51.37	1.68	0.17	
			Mean	23.53	3.07	18.32	5.89	49.20	1.55	0.22	
	Carduaceae:	*Artemisia asiatica*	June	19.95	4.26	19.59	9.92	46.29	0.80	0.25	
			Aug.	14.14	3.68	30.60	8.06	43.52	0.79	0.29	
			Oct.	15.43	3.53	24.09	8.15	48.81	0.92	0.27	
			Mean	16.51	3.82	24.76	8.71	46.21	9.84	0.28	

Year	Family	Species	Stage of mat.	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE	Ca	P	Remarks
				%	%	%	%	%	%	%	
		Artemisia japonica	June	11.20	3.26	20.02	8.89	56.63	1.20	0.21	
			Aug.	6.64	3.04	32.44	6.48	51.40	0.68	0.16	
			Oct.	7.55	2.56	27.63	7.89	54.39	1.34	0.14	
			Mean	8.46	2.95	26.70	7.75	54.14	1.07	0.17	
		Artemisia gigantea	June	9.84	3.33	36.02	10.86	39.94	0.10	0.11	
			Aug.	12.36	3 74	34.61	9.24	40.06	0.53	0.19	
			Oct.	7.03	2.53	37.66	7.29	45.49	0.46	0.09	
			Mean	9.74	3.20	36.10	9.13	41.83	0.36	0.13	
	Other:	*Carex birvensis*	June	9.17	2.89	29.42	6.44	52.10	0.24	0.11	
			Aug.	8.98	2.27	30.99	6.67	51.60	0.26	0.10	
			Oct.	—	—	—	—	—	—	—	
			Mean	9.08	2.58	30.21	6.56	51.85	0.25	0.11	

From the retults of 1968, it was indicated that the earlier the growing stage the higher the content of crude protein and the lower the content of crude fiber in grass species in general. There were, however, some exceptions, for example, in the case of *Imperata cylindrica* the crude protein showed ever increasing trend as the stage of maturity progressed. Content of crude protein in June showed the highest figures with slight decreasing tendency until September and dropped sharply thereafter. There was no consistency in fiber content change due to stage of maturity in grass species as a whole.

In legumes, the crude protein content decreased sharply as the stage of maturity progressed, however, no significant difference occurred in the crude fiber content, except *Lespedeza bicolar* in which the fiber content increased as the stage of maturity progressed. There were sharper decreases in the protein content and increases in the fiber content in shrubs and in species of *carduaceae* family. No big change occurred in other chemical compositions such as crude fat and crude ash. From the results obtained in 1969, the decrease of crude protein as the progress of stage of maturity was sharper with the species that had higher initial protein content such as *Eragrostis ferruginea*, *Digitaria sanguinalis*, *Zijania caduciflora*, *Paspalum thunbergii* and *Pennisetum japonica* than the species that had a lower initial crude protein content. The crude protein content of some grass species such as *Zijania caduciflora*, *Paspalum thunbergii* and *Digitaria sanguinalis* dropped as much as 50% of the initial content as the stage of maturity progressed from June to October. Itmay be concluded from the result that native grasses should be cut during the month of August when maximum utilization of crude protein is concerned. Crude fiber content of grass species generally increased sharply from June to August and decreased slightly thereafter (Fig. 1).

In legumes, the decrease of crude protein content as the stage of maturity progressed was greater than in the case of grasses. Crude protein content of *Amorpha fructicosa* and *Astragalus membranacens* decreased from 19.73% and 17.12% in June to 7.71% and 7.23% in October, respectively. Crude fiber content of all the legumes except *Pueraria thunbergiana* and *Lespedeza cytissides* increased as the maturity stage progressed (Fig. 1 and 2).

In *carduaceae* family, crude protein content was decreased as the stage of maturity progressed, and the difference was greater from June to August than from August to October. Content of crude fiber increased from June to August decreased slightly from August to Octber. The reasons of the decrease of fiber content in late growing stage are not known.

Crude fat content of all the grasses analyzed except *Themeda japonica*, *Calamgrostis arundinacea*, *Festuca ovina* and *Zoysia japonica* decreased as the stage of maturity progressed. Three different types occurred in

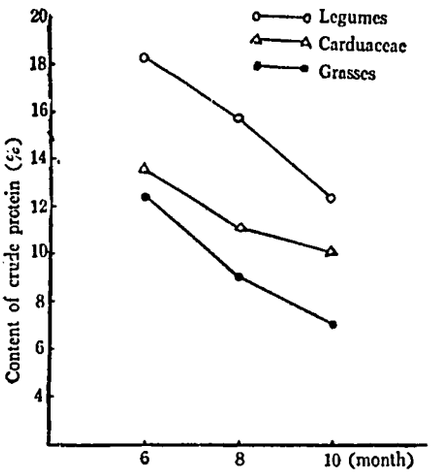

Fig 1. Seaonal changes in crude protein content (mean of 1969)

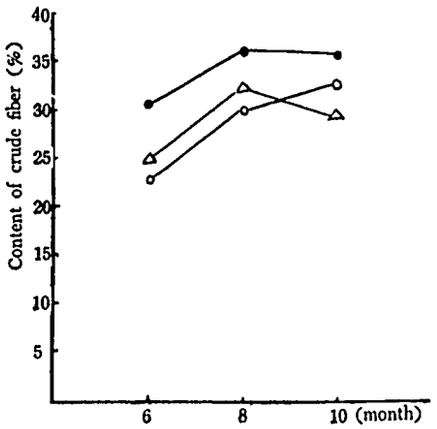

Fig 2. Seasonal changes in crude fiber content (mean of 1969)

legumes that (1) fat content increased from early growing stage to late growing stage such as *Lespedeza cuneata*, (2) that fat content decreased from June to August and thereafter increased such as *Lespedeza cytissides* and *Lespedeza striata*, and (3) that fat content increased from June to August and decreased from August to October.

Effect of growing stage on the content of Ca and P are summarized in Table 4.

Table 4. Effect of stage of maturity on Ca and P content (Average, %).

	Ca			P		
Family	June	Aug.	Oct.	June	Aug.	Oct.
Grasses	0.31	0.28	0.25	0.21	0.20	0.16
Legumes	1.18	1.20	1.21	0.19	0.23	0.15
Carduaceae	0.70	0.68	0.91	0.20	0.21	0.17

Although the content of Ca and P in grasses appeared to be decreased, as the stage of maturity progressed, that of legumes did not change very much. No big difference was found in the content of P in all families.

(2) Mixed grasses

Mixed grasses were collected from seven different locations, i.e. Yongin, Jinju, Andong, Kueje, Jirisan, Daekwannyung and Suwon area in June, August and October and their chemical compositions are summarized in Table. 5

Crude protein content of mixed grasses dropped sharply from August to October but no clear picture was obtainable from June to August. As shown in the table 5, in the mixed grasses which originated from Yongin, Jinju and Andong area, the crude protein content remained unchanged or increasesd slightly whereas the crude protein content of mixed grasses which originated from Daekwannyung and Suwon area decreased from June to August. It may be thought from the results that this difference was due to different botanical compositions of mixed grasses and area differences.

Crude fiber content was increased, in general, from August to October with a few exceptions.

Table 5. Seasonal Changes in chemical composition of mixed native herbage plants (D.M.%).

Year	Origin of mixed grasses	Stage of maturity	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE
			%	%	%	%	%
1969.	Yongin	June	5.98	0.32	36.77	12.11	44.82
		Aug.	6.33	0.43	38.42	5.16	49.66
		Oct.	4.50	1.44	42.86	5.01	46.19
		Mean	5.60	0.73	39.35	7.43	46.89
	Jinju	June	7.60	0.70	40.46	6.13	45.11
		Aug.	7.86	1.03	41.34	6.39	43.84
		Sept.	6.34	0.36	42.50	6.55	44.25
		Mean	7.27	0.69	41.43	6.36	44.40
	Andong	June	6.16	1.36	37.21	6.13	49.13
		Aug.	7.70	0.51	37.86	6.86	47.07
		Sept.	5.88	0.61	37.77	6.53	49.21
		Mean	6.58	0.83	37.61	6.51	48.47
	Kueje	Aug.	6.68	1.46	40.46	7.55	43.84
		Oct.	4.84	1.42	43.80	4.96	44.98
		Mean	5.76	1.44	42.13	6.26	44.41
	Jirisan	Aug.	8.61	1.20	41.01	6.26	42.92
		Oct.	6.29	0.98	45.28	5.35	42.09
		Mean	7.45	1.09	43.14	5.80	42.51
	Daekwannyung	June	7.24	—	40.10	6.79	45.87
		Aug	6.95	0.42	40.48	5.14	47.01
		Oct.	3.86	1.41	48.87	5.52	40.34
		Mean	0.02	0.61	43.15	5.82	44.41
	Suwon	June	9.61	1.74	34.44	5.94	48.27
		July	7.03	2.68	39.02	8.68	42.59
		Aug.	6.85	1.42	34.17	5.46	52.10
		Mean	7.83	1.95	35.88	6.69	47.65

In general, as has been discussed previously the crude protein content decreased whereas the crude fiber content increased as the stage of maturity progressed. These relationships are expressed in Fig. 3 and Fig. 4. Relationship between the stage of maturity and the content of crude protein or crude fiber are expressed in the following equations; where, Y=crude protein content or crude fiber content in percentage and X=stage of maturity in month.

Family	Nutrients	Regression equation	$S_{y.x}$	r^2
Grasses	C. protein	$Y=16.31-0.93X$	0.786	0.269
Legumes		$Y=27.66-1.53X$	0.890	0.332
Grasses	C. fiber	$Y=0.63X+29.85$	0.291	0.089
Legumes		$Y=2.17X+10.93$	1.450	0.228

Similar results were also published by Kim *et al.* (1968)[15] with 19 different herbage species. Han *et.al.* (1970)[4], Han (1969)[5], and Park *et al.* (1968)[22] obtained similar results. Recently Yun (1968)[29] also reported that crude protein content and digestibility of *Arundinella hirta* decreased as stage of maturity progressed.

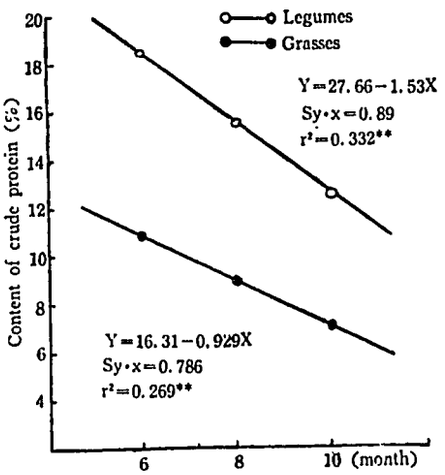

Fig. 3. Relationship between stage of maturity and crude protein content.

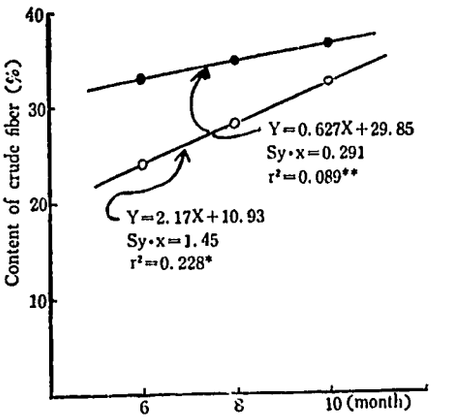

Fig. 4. Relationship between stage of maturity and crude fiber content.

c. Location difference in chemical composition

(1) Location difference in chemical composition

A total of 10 different native herbage plants including 5 grass species and 3 legumes were collected from Yongin, Songhwan, Jinju and Jeju area in 1968 and 22 different native herbage plants including 15 grass species and 5 legumes were also collected from mountain areas (Daekwannyung, Jirisan), hilly area (Yongin, Andong, Jinju), island area (Jeju, Kueju) and paddy areas (Hwasan, Kwangsan, Yiri) in 1969. Chemical composition data of those herbage plants analyzed are presented in Table 6.

Table 6. Location difference in chemical composition of some native herbage plants (%).

Year	Family	Species	Location	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE
				%	%	%	%	%
1968	Grass	*Zoysia japonica*	Yongin	8.88	1.76	29.53	7.39	52.43
			Songhwan	8.07	3.35	32.74	4.83	51.02
			Jinju	—	—	—	—	—
			Jeju	—	—	—	—	—
		Imperata cylindrica	Yongin	—	—	—	—	—
			Songhwan	7.91	2.73	37.04	5.18	47.14
			Jinju	5.91	0.93	34.20	4.71	54.26
			Jeju	5.63	1.63	32.39	4.07	56.29
		Miscanthus purpurascens	Yongin	12.03	1.15	33.23	4.94	48.65
			Songhwan	7.03	2.57	37.57	5.17	47.66
			Jinju	10.95	1.31	28.19	7.24	52.32
			Jeju	5.01	1.71	32.29	3.73	57.28
		Digitaria sanguinalis	Yongin	8.39	1.64	29.01	7.80	53.17
			Songhwan	11.94	3.59	31.47	8.59	44.41
			Jinju	14.52	2.87	27.46	10.66	44.50

Year	Family	Species	Location	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE
				%	%	%	%	%
			Jeju	—	—	—	—	—
		Eragrostis ferruginea	Yongin	7.13	1.07	30.75	6.14	54.92
			Songhwan	7.94	2.79	37.64	4.46	47.17
			Jinju	9.09	2.08	33.85	6.10	48.88
			Jeju	—	—	—	—	—
	Legume	*Pueraria thunbergiana*	Yongin	12.82	1.18	32.46	6.60	46.94
			Songhwan	21.49	4.72	22.45	7.14	44.20
			Jinju	—	—	—	—	—
			Jeju	—	—	—	—	—
		Cassia nomame	Yongin	—	—	—	—	—
			Songhwan	16.82	6.21	27.90	3.67	45.57
			Jinju	19.19	2.74	23.90	5.02	49.16
			Jeju	14.14	3.39	27.02	4.22	54.56
		Lespedeza striata	Yongin	—	—	—	—	—
			Songhwan	14.37	3.74	30.80	5.29	45.81
			Jinju	16.69	2.99	30.86	7.84	41.61
			Jeju	17.39	3.50	26.52	5.47	47.14
	Mixed	Mixed grasses	Yongin	4.92	1.37	31.58	4.20	57.93
			Suwon	6.35	2.14	32.04	7.26	52.21
			Daekwn-nyung	7.03	2.68	39.02	8.68	42.59
			Paddy field	11.51	1.83	29.83	10.42	46.41
			Hill side	6.15	1.36	33.56	6.09	52.84
	Shrub	*Robinia pseudo acacia*	Yongin	20.43	2.99	16.77	5.85	53.96
			Songhwan	27.10	5.12	13.11	4.97	49.69
			Jinju	—	—	—	—	—
			Jeju	—	—	—	—	—

Year	Family	Species	Location	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE	Ca	P
				%	%	%	%	%	%	%
1969	Grass	*Arundinella hirta*	Kwangsan	5.21	1.32	37.16	4.56	51.75	0.16	0.08
			Jinju	5.95	1.63	37.87	4.89	49.66	0.25	0.11
			Jirisan	5.57	1.49	37.79	4.55	49.75	0.28	0.13
			Yongin	3.68	1.08	37.74	4.70	53.15	0.28	0.05
			Hwasan	5.10	1.14	39.91	5.17	48.69	0.19	0.10
			Andong	7.09	1.51	35.65	6.48	49.27	0.40	0.16
			Kueje	5.37	1.08	35.84	5.18	52.81	0.22	0.12
			Yiri	7.18	0.98	36.73	5.45	49.68	0.18	0.12
			Daekwn-nyung	5.65	1.14	39.72	3.92	49.60	0.26	0.09
		Phragmites prosturatus	Kwangsan	13.65	1.83	34.25	8.69	41.58	0.17	0.12
			Jinju	14.55	2.44	33.70	6.64	42.66	0.23	0.16

Year	Family	Species	Location	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE	Ca	P
				%	%	%	%	%	%	%
			Jirisan	14.28	1.68	31.09	12.85	40.10	0.21	0.14
			Yongin	16.49	2.30	29.03	14.31	39.87	0.20	0.17
			Andong	13.93	1.98	29.91	9.96	44.22	0.33	0.17
		Themeda japonica	Kwangsan	6.62	1.67	37.46	5.21	49.05	0.18	0.12
			Jinju	6.25	1.63	38.91	6.13	47.08	0.25	0.11
			Jirisan	5.80	1.47	39.47	5.63	47.63	0.23	0.09
			Yongin	4.29	1.93	39.01	6.06	48.71	0.18	0.05
			Hwasan	7.13	1.25	39.32	5.12	48.17	0.69	0.11
			Andong	4.06	1.02	37.04	5.27	52.62	0.26	0.12
			Kueje	5.74	1.44	38.43	6.10	50.96	0.19	0.12
			Jeju	5.40	0.90	36.25	8.18	49.26	0.22	0.14
			Yiri	6.62	1.39	37.72	5.71	48.58	0.22	0.11
			Daekwan-nyung	7.73	2.29	24.52	15.57	49.88	1.05	0.14
		Miscanthus purpurascens	Kwangsan	5.71	1.54	36.61	4.95	51.20	0.14	0.09
			Jinju	6.98	1.42	39.16	5.41	47.03	0.24	0.13
			Jirisan	6.32	2.10	38.59	5.31	47.68	0.22	0.10
			Yongin	4.00	1.32	37.98	5.23	51.47	0.29	0.07
			Hwasan	5.09	0.94	37.72	5.56	50.68	0.19	0.10
			Andong	7.77	1.11	37.09	5.26	48.77	0.38	0.17
			Kueje	6.83	1.20	36.44	5.88	49.65	0.19	0.15
			Jeju	4.82	1.35	39.73	5.68	48.43	0.16	0.12
			Daekwan-nyung	6.46	1.61	40.08	5.32	46.53	0.25	0.10
		Eragrostis ferruginea	Kwangsan	9.72	2.65	34.38	5.93	47.32	0.24	0.28
			Jinju	9.40	2.07	33.51	6.88	48.13	0.27	0.25
			Jirisan	8.35	2.18	34.10	5.62	49.74	0.25	0.17
			Yongin	9.21	2.33	33.01	6.04	49.41	0.25	0.28
			Hwasan	8.46	2.21	33.07	5.50	50.76	0.19	0.18
			Andong	8.93	1.59	32.91	7.51	49.08	0.29	0.32
			Kueje	10.11	1.65	32.22	7.03	48.99	0.27	0.29
			Yiri	10.50	1.60	36.28	6.83	44.80	0.26	0.34
		Imperata cylindrica	Kwangsan	7.08	1.79	38.25	4.44	48.44	0.21	0.13
			Jinju	7.91	2.46	41.60	4.82	43.23	0.21	0.18
			Jirisan	5.52	1.80	34.04	4.47	54.18	0.27	0.09
			Kueje	7.10	1.82	37.71	5.00	48.37	0.25	0.13
			Jeju	6.07	1.63	39.48	4.70	47.13	0.23	0.13
		Zijania caduciflora	Kwangsan	10.87	2.48	32.35	11.40	42.99	0.18	0.12
			Jinju	12.38	2.43	33.27	10.75	41.17	0.23	0.14
			Yiri	13.14	0.72	35.19	13.84	37.12	0.24	0.16
		Paspalum thunbergii	Kwangsan	8.05	1.95	34.17	7.13	48.71	0.25	0.16
			Jirisan	8.73	2.08	38.67	7.53	42.99	0.28	0.17
			Yiri	12.38	1.80	33.50	8.68	43.65	0.24	0.22
		Cymbopogon goeringii	Kwangsan	6.40	2.43	35.99	5.12	50.06	0.24	0.09

Year	Family	Species	Location	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE	Ca	P
				%	%	%	%	%	%	%
			Jinju	6.55	4.09	36.86	5.60	46.90	0.36	0.11
			Jirisan	5.85	3.29	37.69	4.90	48.28	0.22	0.12
			Yongin	5.79	3.53	36.72	5.11	48.85	0.30	0.06
			Hwasan	6.57	3.41	39.29	5.50	45.25	0.17	0.11
			Andong	5.98	2.15	33.44	6.16	52.26	0.33	0.16
			Kueje	7.19	3.24	34.24	6.06	49.27	0.26	0.17
			Jeju	4.23	3.00	36.88	5.09	41.25	0.19	0.10
			Yiri	7.54	2.03	36.43	6.00	48.00	0.24	0.14
		Eulia speciosa	Kwangsan	4.70	1.77	40.28	4.62	48.63	0.22	0.09
			Jinju	5.09	1.66	39.46	5.35	48.46	0.21	0.10
			Jirisan	12.52	2.88	32.57	8.11	43.93	0.24	0.14
			Andong	7.26	1.75	32.96	6.42	51.62	0.43	0.16
			Kueje	5.70	1.74	38.58	5.12	48.87	0.21	0.10
			Yiri	6.94	1.37	41.14	6.08	44.48	0.17	0.12
		Digitaria sanguinalis	Kwangsan	9.24	1.38	33.54	7.68	48.17	0.25	0.15
			Jinju	14.58	3.18	28.01	11.13	43.10	0.32	0.41
			Jirisan	8.06	2.67	32.90	8.45	47.93	0.33	0.39
			Andong	12.13	2.13	28.67	11.45	45.63	0.35	0.38
			Kueje	10.36	1.68	32.16	11.37	44.46	0.36	0.29
			Yiri	14.30	2.44	31.35	11.18	41.28	0.23	0.28
		Andropogon micranthus	Kwangsan	5.81	1.10	35.72	6.33	52.25	0.32	0.08
			Jinju	6.24	1.64	35.23	7.86	49.03	0.36	0.11
			Andong	6.70	1.74	34.56	7.68	49.[illegible]	0.36	0.19
			Kueje	3.75	1.04	34.95	8.62	51.6[illegible]	0.19	0.10
			Jeju	5.17	0.74	35.97	9.33	48.78	0.32	0.12
			Yiri	7.29	1.86	31.66	7.47	51.72	0.24	0.13
		Calamagrostis arundinacea	Jinju	8.32	2.09	39.03	8.93	41.63	0.25	0.11
			Jirisan	9.12	1.88	38.29	9.08	41.62	0.19	0.11
			Yongin	7.15	2.34	37.18	8.44	44.88	0.24	0.08
			Hwasan	10.42	2.40	36.32	9.[illegible]7	40.90	0.29	0.16
			Andong	7.57	1.53	37.46	6.04	47.42	0.39	0.16
			Kueje	7.54	1.58	40.03	8.71	42.15	0.24	0.14
		Eccoilopus cotulifer	Jinju	6.38	1.22	36.68	5.29	50.38	0.52	0.11
			Jirisan	8.24	1.93	38.55	5.96	47.13	0.37	0.14
			Andong	7.75	1.65	35.22	6.61	48.76	0.53	0.19
			Kueje	7.38	1.51	37.18	6.04	47.86	0.31	0.14
			Daekwan-nyung	7.65	1.01	39.15	5.01	47.18	0.41	0.09
		Pennisetum japonica	Jinju	10.59	2.10	33.78	8.56	44.96	0.35	0.25
			Jirisan	8.72	1.87	35.12	7.40	46.89	0.32	0.17
			Andong	6.55	1.69	39.07	7.50	45.19	0.31	0.21
			Kueje	5.45	1.80	37.68	9.18	45.89	0.24	0.29
	Legume	*Lespedeza cuneata*	Kwangsan	12.88	2.08	36.12	4.85	44.07	0.65	0.16
			Jinju	11.96	2.11	39.19	4.89	41.85	1.07	0.47
			Jirisan	13.88	2.14	31.89	4.48	47.63	0.93	0.16

Year	Family	Species	Location	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE	Ca	P
				%	%	%	%	%	%	%
			Hwasan	14.05	1.61	31.40	7.88	45.07	0.86	0.20
			Andong	12.08	2.54	31.28	4.45	50.00	1.05	0.15
			Kueje	13.51	1.57	34 48	5.03	45.41	0.92	0.15
			Jeju	12.86	2.04	36.51	5.03	43.55	0.87	0.15
			Yiri	11.80	1.10	39.47	3.92	43.71	0.78	0.16
		Lespedeza cytissides	Kwangsan	16.14	3.56	19.81	3.45	57.03	0.49	0.11
			Jinju	15.12	3.33	21.57	4.10	55.88	0.84	0.11
			Andong	13.75	3.66	20.89	7.16	54.54	2.03	0.14
			Yiri	11.31	2.95	24.01	7.43	49.15	0.50	0.11
		Lespedeza striata	Kwangsan	15.89	3.03	32.25	6.12	42.70	1.07	0.26
			Jinju	15.49	3.44	36.25	5.93	39.24	0.77	0.33
			Hwasan	15.79	4.34	29.21	6.32	44.67	0.60	0.57
			Andong	15.16	2.40	29.42	6.14	46.88	1.06	0.19
			Kueje	15.36	1.75	37.43	8.82	36.66	0.92	0.25
			Yiri	15.96	1.92	33.21	5.67	43.25	0.91	0.24
			Daekwan-Nyung	19.75	2.11	32.46	6.28	39.40	1.07	0.27
		Pueraria thunbergiana	Kwangsan	—	—	—	—	—	—	—
			Jinju	17.08	2.31	29.60	9.30	41.39	1.09	0.19
			Jirisan	15.07	2.68	33.42	6.84	38.97	1.56	0.16
			Yongin	13.07	2.31	35.38	5.74	43.49	1.29	0.10
			Andong	12.50	1.83	31.76	8.58	45.33	2.33	0.23
			Kueje	20.91	2.38	26.01	8.05	42.69	1.72	0.20
		Lespedeza spp.	Jirisan	14.07	3.64	30.35	3.82	48.11	0.90	0.23
			Yongin	12.47	3.87	28.26	3.66	51.75	1.07	0.09
			Hwasan	12.79	2.69	40.03	4.93	39.57	1.01	0.15
			Andong	12.71	4.49	29.69	4.99	48.12	1.43	0.14
			Jeju	17.98	2.36	32.40	3.99	43.64	0.89	0.22
			Yiri	14.21	2.12	37.54	4.55	41.59	0.74	0.13
	Carduaceae	*Artemisia asiatica*	Jirisan	19.48	3.45	26.13	9.76	41.22	0.75	0.23
			Yongin	14.74	3.49	24.37	8.06	48.99	0.87	0.28
			Hwasan	16.36	4.82	22.75	8.92	47.17	0.81	0.29
			Daekwan-nyung	20.80	2.35	24.73	9.71	42.41	0.87	0.24
		Artemisia japonica	Yongin	8.91	3.21	24.99	7.91	54.96	0.97	0.14
			Hwasan	6.76	2.91	24.44	8.61	57.95	1.20	0.13
			Jeju	9.72	2.73	31.32	6.73	49.50	1.06	0.23

Location difference in chemical composition was found to be fairly high in magnitude regardless of species within the family or between families as is illustrated in Table 6. The results obtained in 1968 indicated that the smallest difference between location was crude protein content of 0.76% of *Zoysia japonica* between Songwhan and Yongin. Crude protein content of all other species showed more than 2% difference by the locations. The largest area difference in crude protein content was 8.67% in *Pueraria thunbergiana*. The cause was thought to be that the former was grown in more highly fertile land than the latter. The crude protein content of *Miscanthus purpurascens* grown in Yongin area was 12.03% and that grown in Jeju area

was only 5.01%. These location changes in other chemical compositions such as crude fat and fiber also existed due mainly to different climatic conditions, soil fertility and sampling errors.

In the results obtained in 1969, the same tendency was apparent as was shown in the previous year. The content of Ca and P varied more severely than proximate composition between locations and suggested the possibility that the content of Ca and P might have been affected directly by soil conditions. It may be concluded from the above results that it is unwise to accept limited chemical composition data obtained from certain areas compared to other areas.

(2) Location difference in mean chemical composition

Twenty-two native herbage plants were averaged for their chemical compositions and Ca, P contents according to the different locations and to the different stage of maturity and presented in Table 7.

Table 7. Location difference in mean chemical composition of native herbage plants(%).

Location	Stage of maturity	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE	Ca	P
		%	%	%	%	%	%	%
Daekwannyung	June	11.57	2.29	30.98	7.77	47.40	0.87	0.15
	Aug.	10.47	2.33	35.95	7.95	43.30	1.05	0.15
	Oct.	6.26	1.61	39.15	6.66	46.32	0.75	0.07
	Mean	10.40	2.11	34.30	7.51	45.68	0.89	0.12
Jirisan	June	12.90	2.56	31.95	7.01	45.57	0.50	0.18
	Aug.	8.86	2.38	36.88	6.92	44.96	0.40	0.17
	Oct.	6.84	1.87	35.75	6.56	48.98	0.44	0.11
	Mean	9.62	2.24	34.91	6.85	46.39	0.45	0.15
Yongin	June	12.27	3.42	26.18	6.67	51.47	0.63	0.15
	Aug.	10.22	2.59	35.01	6.23	45.94	0.60	0.13
	Oct.	7.52	1.65	34.55	5.84	50.44	0.74	0.10
	Mean	10.10	2.56	31.79	6.39	49.15	0.66	0.13
Andong	June	13.68	2.33	28.13	7.05	48.81	0.80	0.22
	Aug.	10.92	2.29	33.63	7.34	45.82	0.71	0.22
	Oct.	11.75	2.20	31.02	7.46	47.58	1.06	0.20
	Mean	11.99	2.26	31.42	7.38	46.94	0.86	0.21
Jinju	June	13.17	3.03	30.99	6.79	46.02	0.58	0.22
	Aug.	10.25	2.02	37.74	6.56	43.44	0.56	0.16
	Oct.	7.26	1.63	37.78	7.20	46.14	0.33	0.13
	Mean	10.85	2.30	34.76	6.55	45.54	0.47	0.17
Jeju	June	12.06	1.67	32.23	7.50	46.54	0.66	0.19
	Aug.	8.54	0.05	36.93	5.59	46.89	0.58	0.15
	Oct.	7.45	1.63	38.08	6.05	46.79	0.52	0.14
	Mean	9.38	1.73	35.89	6.35	46.66	0.59	0.16
Kueje	June	11.06	1.44	29.89	7.00	50.61	0.50	0.17
	Aug.	11.78	2.52	33.95	6.69	45.06	0.52	0.23
	Oct.	7.28	1.77	36.75	7.12	47.09	0.41	0.17
	Mean	10.39	1.93	32.72	7.07	47.89	0.48	0.19
Hwasan	June	10.83	2.66	27.62	6.30	52.59	0.66	0.14
	Aug.	11.54	2.72	33.37	5.82	46.55	0.58	0.19
	Oct.	8.69	2.26	35.28	6.60	47.18	0.53	0.13
	Mean	10.37	2.52	32.56	6.14	48.42	0.59	0.15

Location	Stage of maturity	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE	Ca	P
		%	%	%	%	%	%	%
Kwangsan	June	11.24	3.01	30.61	6.54	48.60	0.35	0.17
	Aug.	9.02	1.89	36.73	6.01	46.35	0.39	0.14
	Oct.	6.76	1.36	37.92	5.61	48.35	0.22	0.12
	Mean	9.45	2.19	34.26	5.98	48.12	0.32	0.14
Yiri	June	11.81	2.50	33.61	6.55	45.55	0.34	0.17
	Aug.	10.45	0.93	37.42	7.56	43.63	0.39	0.18
	Oct.	—	—	—	—	—	—	—
	Mean	10.89	1.68	35.84	7.08	44.52	0.37	0.18

It appeared from Table 7 that location difference in mean chemical composition was not great. Mean crude protein content of herbage collected from hilly areas (Yongin, Andong, Jinju) showed slightly higher value than that collected from mountain areas (Daekwannyung, Jirisan) or island areas (Jeju, Kueje) and vice versa in value of crude fiber content. However, the differences were too small to be recognized (Table 8).

Table 8. Location difference in mean chemical composition of mixed grasses(%).

Location	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE	Ca	P
	%	%	%	%	%	%	%
Mountain area	10.01	2.18	34.61	7.18	46.04	0.67	0.14
Hilly area	10.98	2.37	32.67	6.79	47.21	0.66	0.17
Island area	9.89	1.83	34.31	6.71	47.28	0.54	0.18
Rice paddy area	10.24	2.13	34.22	6.40	47.02	0.43	0.16
Mean	10.31	2.15	33.85	6.73	46.93	0.57	0.16

Kang *et al.* (1969)[14] analyzed the chemical composition of leaves of *Robinia pseudo acacia* collected from different locations and found that the crude protein content varied from location. The result is supported by the present study.

d. Family differnce in content of nutrients

The value of nutrient contents of native herbage plants were averaged according to family and presented in Table 9.

Table 9. Family difference in content of nutrients (DM basis, %)

Year	Family	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE	Ca	P
		%	%	%	%	%	%	%
1968	Grass	8.01	2.69	34.38	6.15	48.77	—	—
	Legume	16.82	4.10	25.99	4.93	48.16	—	—
	Carduaceae	10.29	3.33	26.39	6.58	53.42	—	—
	Shrub	18.19	3.61	27.58	4.95	52.59	—	
1969	Grass	9.36	2.30	34.64	7.57	46.13	0.29	0.19
	Legume	14.26	2.81	29.60	5.83	47.50	1.15	0.17
	Carduaceae	11.57	3.32	29.19	8.53	47.39	0.76	0.19
	Shrub(acacia)	23.53	3.07	18.32	5.89	49.20	1.55	0.22

In general, the content of crude protein and fat in legumes was much higher than those in grass species and vice versa in the content of crude fiber and crude ash. There was no practical difference in P content between legumes and grasses, however, it was about four fold higher in Ca content for the legume family than the grass family. Therefore, it may be concluded that native legumes are better suppliers of Ca for animals when compared to native grasses.

Crude protein content in shrubs was higher than *carduaceae*, and no big differences were found in the content of crude fiber and crude ash between the two families. The very low content of fiber which appeared in shrubs in the result of 1969 was thought to be due to the inclusion of only one analysis of *Robinia pseudo acacia* which was very low in crude fiber content. The contents of Ca and P were much higher in shrubs than in the *carduaceae* family.

In general, the contents of crude protein and Ca were higher in shrubs and in legumes than in grass and in *carduaceae* and vice versa for the content of crude fiber.

e. Burning effect on the chemical composition

To evaluate the burning effect on the chemical composition of native herbage plants, some of the dominant native herbage plants in Jeju area were analyzed for their chemical compositions monthly from May to September. The results are summarized in Table 10.

Table 10. Burning effect on chemical composition of native herbages(%).

Species	Cutting Date	Item	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE
			%	%	%	%	%
Imperata cylindrica	May	Not-burned	6.67	1.55	31.72	4.73	55.34
	June		5.41	0.64	34.02	4.09	55.83
	July		6.33	2.82	32.43	4.31	55.13
	Aug.		4.78	1.35	29.97	3.25	60.64
	Sept.		4.95	1.81	34.79	3.95	54.50
	Mean		5.63	1.63	32.39	4.07	56.29
	May	Burned	12.07	1.83	29.06	5.33	51.72
	June		8.70	0.84	34.51	4.66	51.29
	July		7.06	2.49	37.20	10.90	42.34
	Aug.		6.38	1.80	35.90	4.17	51.74
	Sept.		5.39	2.25	37.81	4.33	50.23
	Mean		7.92	1.84	34.90	5.88	49.46
Cymbopogon goeringii	May	Not-burned	7.23	3.29	27.43	6.87	55.18
	June		4.98	1.15	34.07	3.30	56.50
	July		5.51	4.10	29.76	4.30	56.32
	Aug.		4.78	4.10	30.59	3.78	56.76
	Sept.		4.19	3.90	34.99	3.92	53.00
	Mean		5.34	3.31	31.37	4.43	55.55
	May	Burned	14.09	2.14	24.39	7.44	51.94
	June		9.68	4.37	28.32	5.57	52.05
	July		5.20	3.03	33.12	4.39	54.26
	Aug.		7.12	3.81	26.66	5.40	57.00
	Sept.		4.08	4.16	31.26	3.83	56.63
	Mean		8.03	3.50	28.75	5.34	54.38

Species	Cutting Date	Item	C. Prot.	C. Fat	C. Fiber	C. Ash	NFE
			%	%	%	%	%
Miscanthus purpurascens	June	Not-burned	5.00	0.98	33.80	3.75	56.47
	July		4.83	2.48	35.09	3.94	53.66
	Aug.		5.59	1.99	30.21	3.52	58.69
	Sept.		4.60	1.37	30.05	3.70	60.28
	Mean		5.01	1.71	32.29	3.73	57.28
	June	Burned	7.12	0.66	36.48	3.94	51.80
	July		5.20	1.59	34.62	4.07	54.51
	Aug.		3.68	0.93	35.60	3.69	56.10
	Sept.		5.78	2.21	80.05	5.19	56.76
	Mean		5.45	1.85	84.19	4.22	54.79
Dunbaria villosa	June	Not-burned	15.14	3.23	27.94	4.09	49.60
	July		17.52	4.70	30.78	4.40	43.29
	Aug.		16.17	4.43	24.75	4.34	50.32
	Sept.		18.78	4.38	21.81	4.33	55.70
	Mean		15.65	4.19	26.15	4.29	49.73
Imperata cylindrica	June	Not-burned	20.88	3.32	27.11	4.92	43.77
	July		19.74	5.14	27.65	4.78	42.69
	Aug.		17.33	4.23	22.81	4.08	51.56
	Sept.		14.90	3.38	26.43	4.55	50.74
	Mean		18.21	4.02	26.00	4.58	47.19
Indigofera koreana	June	Not-burned	18.16	4.26	24.55	5.27	47.76
	July		16.24	4.34	23.96	6.23	49.24
	Aug.		18.51	3.95	15.84	6.51	55.18
	Sept.		13.51	4.58	23.74	4.15	54.02
	Mean		16.61	4.28	22.02	5.54	51.55
	June	Burned	—	—	—	—	—
	July		20.71	2.98	17.27	6.01	53.02
	Aug.		18.77	3.16	14.61	6.16	57.30
	Sept.		13.79	3.90	29.66	4.99	47.65
	Mean		17.76	3.35	20.51	5.72	52.66

Burning effect on the content of crude protein and crude ash was significant in the first two months of initial growing period of both grasses or legumes as is illustrated in Fig. 5 and 6. Table 11 also summarizes the burning effect on mean chemical composition according to the stage of maturity and families.

It appeared from the results expressed in the Table 10 that crude protein content of some of the native herbage plants, e.g. *Imperata cylindrica*, *Dunbaria villosa* was higher for burnt than for not-burnt throughout the growing stage, whereas crude protein content of other native herbage plants such as *Cymbopogon goeringii*, *Miscanthus purpurascens* and *Indigofera koreana* was only higher for burnt than for not-burnt for only the first 2 months of growth.

As was shown in Fig. 5 and 6, the crude protein content of grasses differed by 6% in May, 3% in June, and thereafter the difference was narrowed between burnt and not-burnt. A similar tendency was also found with legumes in crude protein content. The burning effect on crude fiber content of grasses and legumes was irregular as shown in Fig. 6. The burning effect on crude ash content showed high values throughout the growing stage in grasses, while little or no change occurred in legumes.

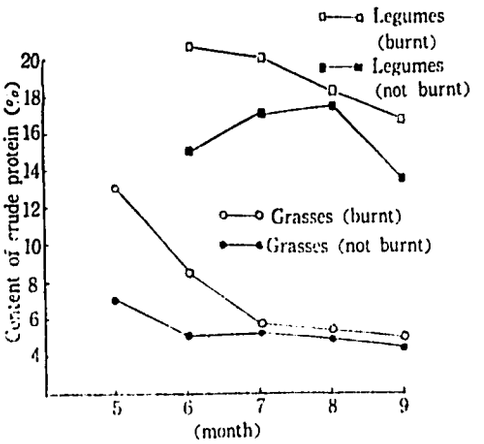

Fig. 5. Burning effect on the crude protein content of native herbages harvested on different growing stage.

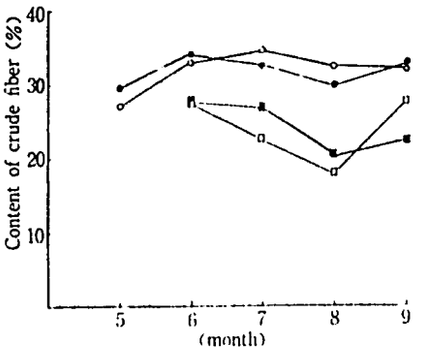

Fig. 6. Burning effect on the crude fiber content of native herbages harvested on different growing stage.

Table. 11. Effect of burning and stage of growth on mean chemical composition of some native herbage plants(%).

Cutting date	Family	Not-Burned C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Burned C. Prot	C. Fat	C. Fib.	C. Ash	NFE
		%	%	%	%	%	%	%	%	%	%
May	Grass	6.95	2.42	29.58	5.80	55.26	13.08	1.98	26.73	6.38	51.83
June	Grass	5.13	0.92	33.96	3.71	56.37	8.50	1.96	33.10	4.72	51.71
	Legume	15.14	3.23	27.94	4.09	49.60	20.88	3.32	27.11	4.92	43.77
July	Grass	5.27	3.13	32.09	4.18	55.04	5.82	2.40	34.98	6.35	50.37
	Legume	16.88	4.52	27.02	5.31	46.26	20.22	4.06	22.46	5.40	47.85
Aug.	Grass	5.05	2.48	30.26	3.52	58.69	5.73	2.18	32.72	4.42	59.95
	Legume	17.34	4.19	20.29	5.43	52.75	18.05	3.69	18.71	5.12	54.43
Sept.	Grass	4.58	2.69	33.28	3.86	55.93	5.08	3.21	33.04	4.50	54.54
	Legume	13.64	4.48	22.78	4.24	54.86	14.35	3.64	28.04	4.77	49.19

f. Relationship between crude protein content and crude fiber content

Negative correlationship was found between crude protein content and crude fiber content of native grasses and legumes. A linear relationship found between the crude protein and crude fiber of grasses and legumes is presented in Fig. 7. Regression equations with standard error and correlation coefficients are summarized

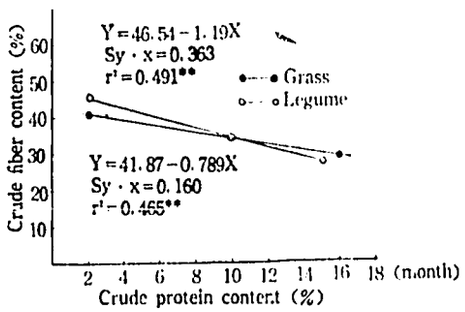

Fig. 7. Relationship between crude protein and crude fiber content of native herbage plants

Table 12. Digestibility and digestible nutrsients of some native herbage plants(%).

Year	Family	Green or Hay	Species	Origin	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	D.M.	En-ergy	TDN D.M.	TDN Wet	DCP D.M.	DCP Wet
1968	Grass	Green	*Miscanthus purpurascens*	Yongin	55.79	40.28	49.90	18.43	62.85	55.85	60.82	55.40	24.05	3.26	1.42
			Eragrostis ferruginea	Yongin	70.26	69.85	80.44	35.23	75.90	74.56	73.75	74.83	31.56	5.22	2.20
			Phragmites prosturatus	Yongin	82.12	71.93	73.33	38.65	65.24	66.94	68.69	64.73	31.93	10.98	5.42
			Calamagrostis arundinacea	Yongin	58.47	34.72	69.45	34.84	64.39	63.12	61.90	62.65	22.19	3.81	1.35
			Agropyrum semicostum	Yongin	46.57	56.40	78.79	21.46	70.37	69.58	68.44	69.82	24.03	2.38	0.82
			Digitaria sanguinalis	Yongin	76.36	59.24	78.24	29.47	74.92	69.69	73.72	69.20	13.72	9.97	1.98
			Zoysia japonica	Suwon	49.48	0	54.67	31.43	50.88	47.35	53.84	46.36	15.53	4.33	1.45
			Mean		62.72	47.49	69.26	29.93	66.36	63.87	65.88	63.28	23.29	5.71	2.09
	Legume		*Lespedeza spp.*	Yongin	54.09	48.38	69.49	27.56	73.04	68.22	64.32	59.61	36.66	56.9	3.00
			Pueraria thunbergiana	Yongin	82.82	60.60	39.96	63.33	87.63	77.93	83.53	70.70	31.69	10.96	4.91
			Securinega subfruticosa	Yongin	69.16	32.08	68.11	43.89	82.09	71.96	69.28	71.66	29.26	6.54	2.57
			Mean		69.69	47.02	59.19	44.93	80.92	72.70	72.38	70.66	32.54	7.73	3.53
	Shrubs		*Robinia pseudo acacia*	Suwon	53.53	0	28.17	28.22	66.99	52.82	52.78	50.82	17.83	12.09	4.24
			Salix glandulosa	Yongin	47.89	41.60	42.84	34.17	67.08	56.72	58.52	55.92	25.54	5.84	2.67
			Quercus dentata	Yongin	38.78	18.00	0	21.80	61.30	43.50	33.20	41.61	21.92	5.21	2.74
			Betula platyphylla	Yongin	68.19	22.53	0	49.48	69.07	53.81	61.05	47.82	23.03	13.64	6.57
			Mean		52.10	20.53	17.75	28.67	66.11	51.71	51.39	49.04	22.08	9.20	4.06
	Others		Mixed grasses (paddy)	Suwon	56.61	0	58.78	5.87	55.01	46.73	53.73	49.23	12.43	5.93	1.50
			Mixed grasses (hill)	Suwon	48.88	13.75	52.87	9.43	0	52.77	53.24	20.96	9.41	3.34	1.50
			Mean		53.75	6.88	55.83	7.65	27.51	49.75	53.49	35.10	10.92	4.64	1.50
	Grass	Hay	*Miscanthus purpurascens*	Yongin	80.91	0	54.88	21.39	42.62	50.26	47.20	45.51	41.10	9.73	8.79
			Eragrostis ferruginea	Yongin	46.13	44.87	71.72	14.28	62.49	60.40	59.14	59.90	53.77	3.29	2.62
			Phragmites prosturatus	Yongin	69.77	60.44	46.10	35.25	49.66	49.35	54.06	45.00	41.37	5.34	4.91
			Calamagrostis arundinacea	Yongin	57.95	31.94	57.29	29.42	58.37	55.10	54.73	54.52	48.97	3.26	2.93

Year	Family	Green or Hay	Species	Orgin	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	D.M.	En-ergy	TDN D.M.	TDN Wet	DCP D.M.	DCP Wet
1968	Grass	Hay	*Agropyrum semicostum*	Yongin	41.77	52.74	61.25	28.96	54.26	54.14	50.63	54.34	48.76	2.00	1.80
			Digitaria sanguinalis	Yongin	59.52	31.62	52.22	35.75	62.70	56.98	54.34	54.88	49.14	4.99	4.47
			Zoysia japonica	Suwon	58.45	21.34	62.76	21.18	52.93	54.39	55.45	54.01	49.08	5.19	4.72
			Mean		58.36	34.71	58.04	26.60	54.73	54.37	53.65	52.59	47.46	4.83	4.32
			Lespedeza spp.	Yongin	43.84	60.58	32.07	38.10	56.98	50.04	47.97	55.02	43.58	4.06	3.67
			Pueraria thunbergiana	Yongin	63.62	0	43.43	41.11	58.16	49.08	45.15	44.85	39.66	8.15	7.21
			Securinega subfruticosa	Yongin	49.71	44.14	35.07	45.43	62.01	53.25	41.42	47.78	42.83	3.91	3.50
			Mean		52.39	34.91	36.86	41.55	59.05	50.79	44.85	49.22	42.02	5.37	4.79
	Shrubs		*Robinia psudo acacia*	Suwon	45.11	31.55	28.24	30.49	64.28	51.38	42.50	50.75	45.30	9.21	8.23
			Salix glandulosa	Yongin	22.45	0	34.59	31.74	58.96	47.75	49.09	45.14	40.90	2.93	2.61
			Quercus dentata	Yongin	43.96	11.92	41.54	9.97	53.67	45.93	48.15	44.09	39.33	4.87	4.34
			Betula platyphylla	Yongin	55.19	0	24.19	13.07	54.66	40.39	37.61	38.82	35.98	9.96	9.23
			Mean		41.68	10.82	32.14	21.32	58.64	46.36	43.84	44.70	40.38	6.74	6.10
	Others (1)		Mixed grasses (paddy)	Suwon	67.37	20.02	66.04	42.84	55.94	58.43	59.96	54.00	48.98	7.75	7.03
			Mixed grasses (hill)	Suwon	57.28	49.24	65.85	43.49	46.16	53.38	52.64	51.12	46.74	3.52	3.22
			Mixed grasses	Yongin	27.79	3.63	31.77	5.49	54.68	44.87	42.42	43.57	39.12	1.61	1.41
			Mixed grasses	College	40.80	52.73	56.52	28.99	51.96	50.40	48.62	50.13	44.60	2.59	2.31
			Mean		48.31	31.41	55.07	30.20	52.19	51.77	50.91	49.71	44.86	3.87	3.49
	Others (2)		Mixed grasses 1	Daekwan-nyung	44.44	31.71	59.35	39.27	49.29	50.86	48.08	49.75	44.41	4.27	3.79
			Mixed grasses 2	〃	37.58	47.47	47.42	57.07	42.87	46.45	44.48	41.60	38.19	2.64	2.43
			Mixed grasses 3	〃	53.88	33.34	23.77	40.94	59.27	50.11	47.56	45.71	42.60	3.90	3.63
			Mean		45.30	37.51	43.51	45.76	50.48	49.14	46.71	45.69	41.73	3.54	3.28

as follows; where X=crude protein in percent and Y=crude fiber content in percent.

Family	Regression equation	Syx	r^2
Grass	$Y=41.87-0.789X$	0.160	0.465
Legume	$Y=46.54-1.190X$	0.363	0.491

The equations obtained in the present study are very similar to those reported by Han *et al.* (1970)[4]; $Y=43.46-1.01X$ (grasses) and $Y=48.01-1.24X$ (legumes)

2. Digestibility and Digestible Nutrients of Native Herbage Plants

a. Digestion coefficients and digestible nutrients

A total of 14 different herbage plants and 7 different mixed grasses were collected in the form of green material and hay mainly from Yongin, Suwon and Daekwannyung areas to determine digestibility and digestible nutrients. The results are presented in Table 12.

In the grass species of green material tested, digestibility of crude protein was the highest for *Phragmites prosturatus* (82%) followed by *Digitaria sanguinalis* (76.4%) and *Eragrostis ferruginea*(70.3%). Digestibility of crude protein of *Calamagrostis arundinaceae* (58.5%), *Miscanthus purpurascens* (55.8%), *Agropyrum semicostum* (46.6%) and *Zoysia japonica* (49.5%) was all relatively low when compared to other species tested. Digestion coefficient of crude fat of *Phragmites prosturatus* (71.9%) and *Eragrostis ferruginea* (69.9%) was relatively higher than other grass species. Digestibility of crude fiber of *Eragrostis ferruginea* (80.4%), *Agropyrum semicostum* (78.8%) *Digitaria sanguinalis* (78.2%) and *Phragmites, prosturatus* (73.3%) was also higher than other grass species. Mean crude fiber digestibility of grasses was 69.3% which appeared to be relativey high.

Digestibility of NFE for *Eragrostis ferrruginea, Digitaria sanguinalis, Agropyrum semicostum* and *Phragmites prosturatus* was much higher than other grass species. *Zoysia japonica* had the lowest digestibility of 50.9%. Digestibility of DM or energy showed the similar trend as of crude fiber, crude protein and NFE. The mean DM digestibility of 63.9% appeared to be relatively high. It was found that species which had high DM or energy digestibility were *Eragrosti. ferruginea* and *Digitaria sanguinalis* followed by *Phragmites prosturatus* and *Agropyrum semicostum.*

When DCP values of native grasses were compared, *Phragmites prosturatus* (11.0%), *Digitaria sanguinalis* (10.0%) and *Eragrostis ferruginea* (5.2%) had higher DCP than other grass species which had less than 4%. When TDN values were compared, the highest TDN value of 74.8% was for *Eragrostis ferruginea*, followed by 69.8% for *Agropyrum semicostum*, 64.7% for *Pharagmites prosturatus*, and 62.7 % for *Calamagrostis arundinacea*, the lowest values were obtained with *Miscanthus purpurascens* and *Zoysia japonica* which had less than 50% of TDN.

As Table 12 indicates, it was found that digestibility of crude protein in green materials of *Pueraria thunbergiana* was 82.8% which showed the highest digestibility in legumes. Crude protein digestibility of *Securinega subfruticosa* and *Lespedeza spp.* was 69.2% and 54.1%, respectively. The Digestion coefficient of crude fat was the highest for *Pueraria thunbergiana* (60.6%). However, crude fiber digestibility was higher for *Lespedeza spp.* (65.9%) and *Securinega subfruticosa* (68.1%) and was lower for *Pueraria thunbergiana* (40.0%). Digestibility of NFE, DM, and energy of *Pueraria thunbergiana* was the highest, followed by *Securinega subfruticosa* and *Lespedeza spp.* The content of DCP of *Pueraria thunbergiana*

(11.0%) was also the highest, followed by *Securinega subfruticosa* (6.5%) and *Lespedeza spp.* (5.7%). When TDN contents were compared, the TDN content of *Securinega subfruticosa* was the highest value with 71.7% followed by 70.7% for *Pueraria thunbergiana* and 69.6% for *Lespedeza spp.*

The Digestibility of shrubs, in general, was lower than that of the legumes or grasses described above. Digestibility of crude protein of *Betula platyphylla* was the highest (68.2%) and that of *Quercus dentata* was the lowest (38.8%) in shrubs. Digestion coefficients of crude fat and crude fiber showed the similar trend as in crude protein and were generally low in the shrub family. The digestibility of crude fat in *Robinia pseudo acacia* was 0%, and the cause was thought due to increased excretion of metabolic fecal fat during the digestion trial. The reasons for none of the crude fiber in *Quercus dentata* and *Betula platyphylla* being digested are not yet known.

There was not much difference in digestibility of NFE. The highest digestibility of DM and energy was obtained with *Salix glandulosa* followed by *Betula platyphylla* and *Robinia pseudo scacia*. *Quercus dentata* had the lowest digestibility of both DM and energy in the shrub family tested. The content DCP of *Betula platyphylla* (13.6%) was the highest and TDN content of *Salix glandulosa* was the highest among the shrubs. Mean value of TDN in shrubs was lower than that of either legumes or grasses.

Mixed grasses collected from paddy areas showed a much higher content of DCP (5.9%) and TDN (21.1%) than mixed grasses collected from hilly areas. These big differences might have been due to soil conditions and botanical compositions of the mixed grasses studied.

When the green materials of native herbage plants described above were dried (*i.e.* hay), it was found that digestibility of nutrients and the content of digestible nutrients in native hay were considerably depressed when comparison was made with those in green materials as is shown in Table 12. Crude protein digestibility of *Miscanthus purpurascens* (80.9%) was the highest and that of *Agropyrum semicostum* (41.8%) was the lowest among the grass hay studied. Digestibility of crude fat was generally low in all the grasses with the highest value of 60.4% for *Phragmites prosturatus* and the lowest value of 0% for *Miscanthus purpurascens*. The highest digestion confficient of crude fiber was obtained with *Eragrostis ferruginea* (71.7%) followed by *Zoysia japonica* (72.8%) and *Agropyrum semicostum* (61.3%). Present data showed that digestibility of NFE of *Digitaria sanguinalis* (62.7%) was the highest and that of *Miscanthus purpurascens* (42.6%) was the lowest. *Eragrostis ferruginea* showed slightly higher digestibilities of both DM and energy than other grass species.

Direct comparison of present data with the existing data is imposible since very limited data are available concerning the digestibilities of native herbage plants. Chiang (1966, 1967)[11,12] reported digestibility of some nutrients in *Digitaria sanguinalis* as follows; crude protein, 40.08%; crude fat, 47.5%; crude fiber, 68.0%; and NFE, 66.2%. When these figrues are compared to those obtained in the present study, digestibilities of all nutrient reported by Chiang were higher than those reported in the present study except digestibility of crude protein. However, the content of DCP and TDN was vice versa (DCP, 2.7% vs. 5.0%; TDN, 46.6% vs. 54.9%). These difference might have originated from chemical composition of the species and the aniamls used in digestion trials.

There were no great differences in digestibilities of DM and energy for legumes. However, digestibility of crude protein was the highest for *Pueraria thunbergiana* (63.6%) and that of crude fat was the highest for the *Lespedeza spp.* Digestibility of crude fiber was the highest also for *Pueraria thunbergiana* (43.6%). *Securinega subfruticosa* showed the highest NFE digestibility (62.0%). *Pueraria thunbergiana* also showed the highest DCP content (8.2%); however, no practical difference was found in DCP content between *Lespedeza spp.* and *Securinega subfruticosa* in legume family. The TDN content of *Lespedeza spp.* (55.0%) was higher than that of either *Pueraria thunbergiana* or *Securinega subfruticosa*.

Of the results obtained in hay of shrubs, digestibilities of nutrients were, in general, lower than those of

other families as in the case of green materials. Crude fat digestibility was, particularly, low. It may be concluded, therefore, that crude fat in *Salix glandulosa* and *Betula platyphylla* was practically undigested. Digestibility of crude protein was the highest for *Betula platyphylla* (55.2%) and *Quercus dentata* had the highest crude fiber digestibility (34.6%). *Robinia pseudo acacia* showed the highest digestibility of NFE (64.3%) among shrubs.

The digestion coefficients of DM and energy for the all shrubs determined were less than 50% except *Robinia pseudo acacia*. *Betula platyphylla* showed the highest content of DCP (10.0%) followed by *Robinia pseudo acacia* (9.2%) and *Salix glandulosa* had the lowest DCP content (2.9%). TDN content of *Robinia pseudo acacia* (50.8%) was relatively higher than that of other shrubs.

Digestibility of mixed grass hay was higher for the mixed grasses collected from paddy areas than for the mixed grasses collected from hill sides as in the case of green materials. The similar trends were also found between the materials collected at the Agricultural College and in Yongin in which the former represented paddy area while the latter represented mountain area. The content of DCP or TDN was also higher for the mixed grasses collected from paddy area than those collected from hill or mountain area.

Yuk *et al.* (1962)[27] reported digestibilities of native grass hay which were very similar in DCP and TDN contents to those obtained in the present study. However, digestibility of crude protein and NFE was higher and that of crude fat and crude fiber was lower for the former than for the latter. When the results obtained in the present study were compared to those obtained by Lee *et al.* (1965)[18] with orchard grass, none of the species was superior in its digestibility to the orchard grass. *Eragrostis ferruginea* and *Digitaria sanguinalis* were nearly as good as orchard grass in digestibility. DCP and TDN content of *Eragrostis ferruginea*, *Calamagrostis arundinacea* and *Digitaria sanguinalis* were similar to those of rye reported by Chiang (1967)[12].

b. Effect of stage of maturity on nutrient digestibility

(1) *in vivo* results

Table 13. Effect of stage of maturity on digestible nutrients of some native herbage plants(%).

Family	Species	Cutting Date	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	DM	Energy	Wet DCP	Wet TDN
			%	%	%	%	%	%	%	%	%
Grasses	*Miscanthus purparascens*	Aug.	55.79	40.28	49.90	18.43	62.85	55.85	60.82	1.42	24.05
		Sep.	50.83	0	62.84	0	41.55	47.69	47.77	1.17	19.81
		Mean	53.31	20.14	56.37	9.21	52.20	51.77	54.30	1.30	21.93
	Phragmites prosturatus	Aug.	82.12	71.93	73.33	38.65	65.24	66.94	68.69	5.42	31.93
		Sep.	72.85	61.80	48.85	23.48	48.09	47.97	51.12	1.82	23.63
		Mean	77.49	66.87	61.09	31.07	56.67	57.46	59.91	3.62	27.78
	Calamagrostis arundinacea	Aug.	58.47	34.73	69.45	34.84	64.39	63.12	61.90	1.35	22.19
		Sep.	54.44	66.10	57.57	32.95	49.84	51.95	45.11	1.32	21.77
		Mean	56.46	50.42	63.51	33.89	57.12	57.54	53.51	1.33	21.98
Shrub	*Betula platyphylla*	Aug.	68.19	22.53	0	49.48	69.07	53.81	61.05	6.57	23.03
		Sep.	76.73	0	38.21	23.60	68.98	61.19	58.35	5.56	19.49
		Mean	72.46	11.27	19.11	36.54	69.03	57.50	59.70	6.07	21.26
Others	Mixed grasses	Jul.	43.81	40.81	71.10	6.55	65.53	60.83	—	—	—
		Aug.	21.90	56.45	70.45	34.18	57.56	58.15	—	—	—
		Sep.	18.44	0	58.48	6.33	59.46	51.56	—	—	—
		Mean	28.05	32.42	66.68	15.69	60.85	56.85	—	—	—

Five different native herbages were cut in August and in September from Yongin and Daekwannyung area in 1968. Digestibility and digestible nutrients determined are presenetd in Table 13.

In 1969, mixed grasses were collected from Jinju, Andong, Jirisan, Kueje, Yiri, Suwon and Daekwannyung areas in June, August and October. Digestibility and digestible nutrients determined are also presented in Table 14.

Table 14. Effect of location and stage of growth on digestible nutrients of mixed grasses(%).

Location	Cutting date	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	D.M.	En-ergy	TDN Dry	TDN Air dry	DCP Dry	DCP Air dry
		%	%	%	%	%	%	%	%	%	%	%
Jinju	Jun.	41.79	0	64.28	24.43	61.06	55.85	54.56	60.59	52.55	3.18	2.76
	Aug.	43.88	22.27	61.34	22.12	48.67	50.61	48.48	50.65	42.88	3.45	2.92
	Oct.	37.53	0	58.50	5.55	46.59	45.28	45.27	49.17	41.61	2.38	2.01
	Mean	41.07	7.42	61.37	17.37	52.11	50.58	49.44	53.47	45.68	3.00	2.56
Andong	Jun.	36.69	31.43	58.95	36.55	62.76	51.79	56.69	55.99	48.80	2.26	1.97
	Aug.	54.45	3.44	64.70	27.58	60.87	58.97	58.37	57.38	50.22	4.19	3.67
	Oct.	41.29	15.38	51.46	18.83	59.00	51.48	51.27	51.11	44.13	2.47	2.10
	Mean	44.14	16.75	58.37	27.65	60.88	54.08	55.44	54.83	47.72	2.97	2.58
Jirisan	Aug.	40.44	2.48	52.25	28.00	55.68	49.80	47.47	48.88	42.69	3.48	3.04
	Oct.	51.26	34.16	66.39	6.04	59.07	57.85	57.95	57.56	50.99	3.27	2.89
	Mean	45.85	18.32	59.32	17.02	57.38	53.83	52.71	53.22	46.84	3.38	2.97
Kueje	Aug.	37.57	37.78	61.01	49.85	52.09	56.68	50.20	50.45	43.68	2.51	2.17
	Oct.	12.69	33.11	62.76	14.35	42.92	47.50	46.00	48.46	41.96	0.61	0.53
	Mean	25.13	35.45	61.89	32.10	47.51	52.09	48.10	49.46	42.82	1.56	1.35
Yiri	Aug.	66.85	69.48	64.75	44.28	44.20	56.90	56.43	53.22	46.39	8.33	7.25
Suwon	Aug.	58.04	59.61	59.01	33.52	58.22	56.48	54.58	54.26	48.16	5.18	4.60
Daekwan-nyung	Jun.	39.89	0	60.82	38.38	57.29	54.99	51.19	53.55	46.95	2.87	2.53
	Aug.	29.82	0	61.89	26.33	57.84	54.78	51.68	54.45	48.01	2.07	1.83
	Oct.	12.56	19.47	65.92	8.19	42.26	47.94	47.69	50.85	44.33	0.48	0.42
	Mean	27.42	6.49	62.88	24.30	52.46	52.57	50.19	52.95	46.43	1.81	1.59

(a) Digestibility of DM and energy

The results obtained in 1968 indicated that the mean digestibility of DM decreased from August(59.6%) to 52.1% in September and digestibility of energy also decreased from 63.1% in August to 50.6% in September. Decrease in the DM digestibility of 19% of *Phragmites prosturatus* was the most severe in grass species. In energy digestibility, the highest decrease from August to September was observed with *Calamagrostis arundinacea* (26.8%) followed by *Miscanthus purpurascens* (23.1%). The digestibility of DM in *Quercus dentata* increased, whereas digestibility of energy and TDN contents decreased as the stage of growth progressed. It might have been due to the selection of high energy content in *Quercus dentata* by sheep during the digestion trial, though the reasons were not clearly understood.

The results obtained with mixed grasses in 1969 indicated that the digestibility of DM or energy of mixed grasses collected from Jinju and Kueje aeas decreased as the stage of maturity progressed, whereas mixed grasses collected from Daekwannyung area showed a decrease in DM digestibility and a slight increase in energy digestibility from June to August. However, the difference was not great enough to be significant. Digestibility of DM or energy was the highest in August for the mixed grasses collected from Andong area.

About 9% increase in both DM and energy digestibility occurred in the mixed grasses collected from Jirisan as the stage of maturity progressed from August to October. However, no clear explanations were given for this phenomena. The largest decrease in DM digestibility from August to October occured with the mixed grasses in Kueje (9.2%%) followed by Andong mixed grasses (7.5%). In energy digestibility, the largest decrease from August to October occurred in the mixed grasses collected from the Andong area. However, the differences shown above were in much smaller magnitude than those n 1968 results. It appeared from the results that botanical composition in mixed grasses might have been affected to lessen these digestibility differences in 1969. A very important fact found in both years was that the decrease in DM or energy was greater with the species which has higher initial digestibility than the lower ones and that digestibility of DM or energy in September in 1968 and in October in 1969 was less than 50% with most herbage species tested.

(b) Digestability of other nutrients

Of the results obtained with single species in 1968, digestibility of all the nutrients except fiber decreased as the stage of maturity progressed. Digestibility of crude fiber in ***Betula platyphylla*** was none in August and no clear reasons can be given for this result. Digestibility of crude fat in ***Miscanthus purpurascens***, ***Betula platyphylla*** and mixed grasses was also 0% which showed the largest variations among nutrients digestibility.

In 1969, the results obtained with mixed grasses showed that digestibility of crude protein increased from June to August and decreased rapidly from August to October in all areas except Daekwannyung and Kueje where decreasing digestibility was continued as the stage of maturity progressed. Digestibility of crude fat, as in 1968, showed 0% in a few cases, and this was assumed due to the increase of metabolic fecal fat during the digestibility trial. When the digestibilities of fat were averaged according to the month, the highest digestibility was obtained in August as in the case of crude protein. Digestibility of crude fiber was the lowest in August and the highest in June. Although the reason of this change in crude fiber digestibility was not known, botanical composition, climatic conditions, soil fertility and location difference might have effected the variation. Digestibility of crude ash decreased as the stage of maturity progressed in both years. It appeared from the results that inorganic matters in native herbage plants were poorly digested, when they were matured, *i.e.* 17% in 1968 and 10.6% in 1969. Digestibility of NFE was also decreased particulary in ***Miscanthus purpurascens*** (21.4%), ***Phragmites prosturatus*** (17.2%), and ***Calamagrostis arundinaceae*** (14.5%) among single species tested. There were no great differences in NFE digestibility in mixed grasses except those collected from Daekwannyung (15.6%) and from Kueje (9.2%).

(c) DCP and TDN

In general, the content of DCP in native herbage plants decreased as the stage of maturity progressed, although the DCP content was highest during the blooming period(August). The DCP content of ***Phragmites prosturatus*** in August was 5.4% and in September, 1.8%. This showed that DCP content of some grasses decreased sharply as the growing stage advanced.

It is interesting to note that the DCP content of native herbage species harvested in June was lower than those harvested in August, and the DCP content of native species harvested in October was the lowest. These changes were similar to those of digestibility of crude potein and changes in chemical composition. The decrease in DCP content by location was greatest for Kueje(depression of 1.9%). It is, therefore, suggested that harvesting native herbage in August would be preferable to harvesting in October.

The content of TDN in native species regardless of location and family decreased as the stage of maturity progressed. It was found that the depression of TDN in the case of ***Phragmites prosturatus*** was relatively

severe. Seasonal change in TDN content of *Calamagrostis arundinacea* was very small. However,it may be concluded that seasonal changes in TDN content was not very high.

Very little is known about the seasonal changes of digestible nutrients of native herbages. Yun(1968)[20] found that the digestibility of some nutrients in *Arundinellahirta* was significantly decreased as the stage of growth advanced toward maturity.

(2) *in vitro* results

Dry matter digestibility of 7 grasses and 5 legumes was determined by the *in vitro* fermentation method to study the effect of growing stage on DM digestibility. The results obtained are summarized in Table 15

Table 15. Seasonal changes of D.M. digestibility of some native herbage plants determined by *in vitro*(%).

Family	Species	July	August	September	October
		%	%	%	%
Grass	*Miscanthus purpurascens*	39.2	28.7	30.5	29.4
	Arundinella hirta	52.2	46.9	41.0	39.8
	Zoysia japonica	55.3	51.3	41.2	34.1
	Themeda japonica	47.3	42.2	36.7	34.8
	Eragrostis ferruginea	62.7	60.2	58.3	50.2
	Digitaria sanguinalis	77.3	61.2	58.1	49.7
	Setaria viridis	63.2	60.7	61.3	50.3
	Mean	56.3	50.2	46.7	41.2
Legume	*Pueraria thunbergiana*	65.7	60.1	58.6	52.7
	Lespedeza striata	65.7	66.3	59.9	45.3
	Cassia nomame	57.6	41.6	41.1	30.9
	Robinia pseudo acacia	50.2	38.1	40.8	32.7
	Lespedeza bicolor	48.0	35.9	43.2	42.6
	Mean	57.4	48.4	48.7	40.8

Although the DM digestibility of some native species was not changed very much during the period of August and September (*Arundinella hirta*, *Setaria varidis*, *Robinia pseudo acacia* and *Lespedeza bicolor*), it was clear that the DM digestibility of the grass family, in general, was decreased as the growing stage advanced. Change in dry matter digestibility was not observed between legumes harvested in September and August. It may be speculated that this was due mainly to the rainfall distribution of August and September.

It should be pointed out that the DM digestibility data obtained by *in vitro* method were lower than those obtained by *in vivo* method. This could be explained by the fact that the animal could consume the native grasses on the basis of selection. An animal could refuse to take stem part of plants.

Similar results were obtained by Park *et. al.* (1969)[23] who also found that the DM digestibility of native species decreased as the growing stage progressed.

c. Digestibility difference between green materials and dried materials.

To compare the nutrients digestibility and digestible nutrients content of green materials and dried materials (hay) of 7 grasses, 3 legumes and 4 shrubs collected in 1968, a series of digestion trials was conducted with sheep. The results obtained are summarized in Table 16.

Table 16. Digestibility difference between green material and hay(%).

Family	Materials	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	DM	Energy	TDN DM	TDN Wet	DCP DM	DCP Wet
		%	%	%	%	%	%	%	%	%	%	%
Grass	Green	62.72	47.49	69.26	29.93	66.36	63.87	65.88	63.28	23.29	5.71	2.09
	Hay	58.36	34.71	58.04	26.60	54.73	54.37	53.65	52.59	47.46	4.83	4.32
	Difference	4.36	12.78	11.22	3.33	11.63	9.50	12.23	10.69	—	0.88	—
Legume	Green	68.69	47.02	59.19	44.93	80.92	72.70	72.38	70.66	32.54	7.73	3.53
	Hay	52.39	34.91	36.86	41.55	59.05	50.79	44.85	49.22	42.02	5.37	4.79
	Difference	16.30	12.11	22.33	3.38	21.87	21.91	27.53	21.44	—	2.36	—
Shrub	Green	52.10	20.53	17.75	28.67	66.11	51.71	51.39	49.04	22.08	9.20	4.06
	Hay	41.68	10.82	32.14	21.32	58.64	46.36	43.84	44.70	40.38	6.74	6.10
	Difference	10.42	9.72	14.38	7.35	7.47	5.35	7.75	4.34	—	2.46	—

As is seen in Table 16, considerable difference in the nutrient digestibility and digestible nutrient content was found between green and dried materials. In general, the digestibility of nutrients in green materials was higher than that in hay. In green materials of the grass family, the difference of digestibility for DM was 9.5%, and for energy digestibility, it was 12.2%. TDN content was 10.7% and DCP content was 0.9% also higher for green material than hay. Likewise, digestibility of crude fiber, NFE and crude fat of green materials was higher than hay.

In legumes, digestibility of DM (21.9% higher) and energy (27.5% higher) in green materials was much higher than that in dried materials. Therefore, TDN content (21.4% more) was also higher for green materials. Digestibility of crude fiber in green materials was 22.3% higher than in hay, and that of NFE was 21.6% higher than in hay.

Digestibility of nutrients and the content of TDN and DCP in green shrubs was also higher than in dried shrubs. However, the magnitude of difference was much smaller than that of grasses and legumes.

Further experiments may be required to explain why the nutrients digestibility was depressed when they were dried. At present, the following statements would be a part of possible explanations: first, getting wet by rain while the hay was curing; second, loss of leafy material during transportation; third, changing the carbohydrate structure during the preparation of hay.

Shin *et al.* (1969)[26] reported that TDN content for dehydrated *Arundinella hirta* was higher than that for

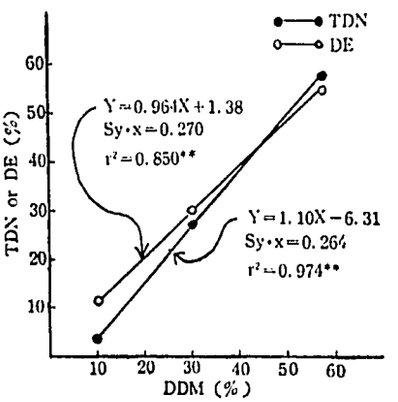

Fig. 8 Relationship between DDM and TDN or DE in grasses.

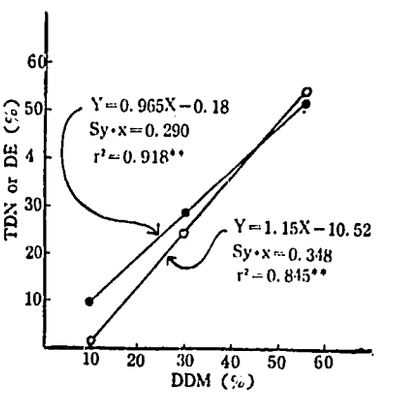

Fig. 9 Relationship between DDM and TDN or DE in legumes and other families.

sun-cured hay. This would mean that some changes that could depress the digestibility of nutrients occurred during the haymaking period.

d. Relationship between DDM and TDN or DE

A linear relationship existing between DDM and TDN or DE of grass family (Fig. 8), legume family (Fig. 9) and mixed native grasses (Fig. 10) was illustrated in following three figures.

A straight linear relationship was found between DDM and TDN ($r^2=0.974$) or DE ($r^2=0.850$) of native grass species as was shown in Fig. 8. Since the errors attached to the estimates are small in magnitude, the regression equations could be used to predeit the content of TDN or DE from DDM that could be determined easily.

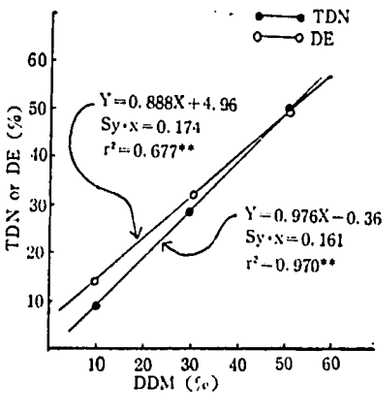

Fig. 10. Relationship between DDM and TDN or DE in mixed herbage plants.

It was found that the same linear relatioship existed between DDM and TDN ($r^2=0.918$) or DE ($r^2=0.845$) of legumes. Figure 10 showed that the relationship between DDM and TDN($r^2=0.970$) or DE($r^2=0.677$) of mixed grasses was also a linear one.

The statistics related to the relationships mentioned above are summarized as follows:

Family	TDN or DE	Regression equation	Syx	r^2
Grass	TDN	$Y=1.10X-6.31$	0.264	0.974
	DE	$Y=0.964X+1.38$	0.270	0.850
Legumes	TDN	$Y=0.965X-0.18$	0.290	0.918
	DE	$Y=1.15X-10.52$	0.348	0.848
Mixed	TDN	$Y=0.976X-0.36$	0.161	0.970
	DE	$Y=0.888X+4.96$	0.174	0.677

3. Effect of fertilizer application on chemical composition and digestibility of native herbage plants.

a. Chemical composition

As a means of improvement of native grassland, 10 kilogram of nitrogen, 7 kilogram of super phosphate and 7 kilogram of potassium per 10 a were applied. This part of the report is to explain the effect of

fertilizer application on the chemical composition, including the content of Ca and P of mixed grasses. For the purpose of comparison, data obtained from Italian rye grass are also included. The results are summarized in Table 17.

Table 17. Effect of fertilizer application on the chemical composition of mixed native grasses and Italian rye grass(%).

Year	Species	Fertilizer	Cutting date	C. Prot.	C. Fat.	C. Fib.	C. Ash	NFE	Ca	P
				%	%	%	%	%	%	%
1968	Mixed grasses	Not-applied	July	7.03	2.68	39.02	8.68	42.59	—	—
		Applied		8.97	1.74	38.99	5.34	44.95	—	—
		Not-applied	August	6.85	1.42	34.17	5.46	52.10	—	—
		Applied		7.29	1.47	33.98	5.44	51.82	—	—
	Italian rye grass	Not-applied	June	11.80	2.32	30.03	8.38	47.47	—	—
		Applied		12.01	2.19	31.54	7.74	46.52	—	—
		Not-applied	July	8.26	1.76	29.52	5.32	55.14	—	—
		Applied		8.80	1.77	28.74	4.85	55.84	—	—
		Not-applied	August	4.06	1.97	32.08	4.58	57.30	—	—
		Applied		6.46	2.25	32.08	5.59	53.61	—	—
1969	Mixed grasses	Not-applied		10.85	2.30	34.76	6.55	45.54	0.47	0.17
		Applied		14.03	2.71	32.65	10.23	40.38	0.30	0.37

From Table 17 it was apparent from the data obtained in 1968 that fertilizer application had significant effects in increasing the crude protein content and decreasing the crude fiber content during the initial stage of growth. However, this type of effect was not apparent at the blooming stage of mixed grasses.

In 1969, the same trend was also found for fertilizer application. Crude protein content was increased, and crude fiber content was decreased by fertilizer application. It was found that the content of crude fat, crude ash and phophorus in the native grasses was also increased. It is, therefore, concluded that the quality of native herbage plants could be improved by fertilizer application.

Crude protein content of Italian rye grass was considerably increased during the initial stage of growth by fertilizer application, although the effect was not clear for the content of crude fiber and crude fat.

Similar results were reported by Kim et al. (1669)[10] who also reported that fertilizer applications increase crude protein content of native grasses that were planted in the experimental field of Jinju Agricultural College.

b. Digestibility

Although the main purpose of using fertilizer would be increasing the productivity of native grasses, increase in the crude protein content (Table 17) and improvement of nutrients digestibility could also be achieved as is seen in Table 18.

Data revealed that the digestion coefficient of DM, crude protein and crude fat during the early stage of growth was improved by fertilizer application. However, there was no effect on the grasses harvested in August. A similar trend was also found for the Italian rye grass but with a different magnitude of improvement.

It is expected that fertilizer application could improve the quality of Korean native herbage plants in terms

Table 18. Effect of fertilizer application on the nutrient digestibility of mixed native grasses and Italian rye grass(%).

Name of grass	Fertlizer	Cutting date	DM	C. Prot.	C. Fat.	C. Fib.	C. Ash	NFE
			%	%	%	%	%	%
Mixed grasses	Not-applied	June	50.86	44.44	31.71	59.35	39.27	49.29
	Applied		---	---	---	---	---	---
	Not-applied	July	46.45	37.58	47.47	47.42	57.07	42.87
	Applied		51.33	56.46	48.60	41.62	45.66	56.46
	Not-applied	August	50.11	53.88	33.34	23.77	40.94	59.27
	Applied		---	---	---	---	---	---
Italian rye grass	Not-applied	June	59.49	59.88	26.30	63.12	33.60	57.96
	Applied		57.28	61.47	19.64	61.50	32.66	59.40
	Not-applied	July	63.18	52.11	34.57	65.27	30.18	68.02
	Applied		66.47	56.56	33.49	68.73	29.04	71.40
	Not-applied	August	59.86	30.35	57.80	60.56	22.21	65.18
	Applied		57.29	61.88	60.45	51.97	46.72	61.45

of chemical composition and nutrient digestibility.

V. Summary

A series of experiments was conducted to study the effect of seasonal changes, maturity stage, location differences, and family differences on the chemical composition and the nutrients digestibility of some widely distributed native herbage plant species in Korea. An attempt was also made to study the effect of fertilizer application on the chemical composition and nutrients digestibility of native herbages. The results obtained are summarized as follows:

1. Chemical composition of green materials.

Sixteen native herbage plants (7 grasses, 3 legumes, 4 shrubs and 2 mixed native grasses) from 2 locations in 1968 and thirty different native species from 10 different locations were collected to analyze the chemical composition including the content of calcium and phosphorus.

Crude protein content for *Phragmites prosturatus*, *Beckmannia erucaeformis*, *Paspalum thunbergii*, *Digitaria sanguinalis*, *Zijania caduciflora* and *Setaria viridis* was higher than other species in the grass family and that for *Lespedeza striata*, *Lespedeza cytissides*, *Lespedeza cuneata*, *Lespedeza spp.* and *Pueraria thunbergiana* was relatively higher than other species in the legume family. Although the crude fiber content of *Robinia pseudo acacia* was lowest among other species studied, crude fiber content of legumes was lower than grasses in general. In grass family *Digitaria sanguinalis*, *Phragmites prosturatus*, *Beckmannia erucaeformis*, *Setaria viridis* and *Paspalum thunbergii* were known to be relatively low in crude fiber content. Although no difference in phosphorus content was found the calcium content for legumes was significantly higher than that for grasses.

2. Effect of stage of maturity on chemical composition.

It was concluded that the crude protein content decreased and the crude fiber content increased as the growing stage progressed toward maturity. The regression equations with related statistics were established as follows (where X=stage of maturity (month), Y=crude protein or crude fiber, %)

Family	Nutrients	Regression equation	Syx	r^2
Grass	C. protein	$Y=16.31-0.93X$	0.786	0.269**
	C. fiber	$Y=0.63X+29.85$	0.291	0.089*
Legume	C. protein	$Y=27.66-1.53X$	0.890	0.332**
	C. fiber	$Y=2.17X+10.93$	1.450	0.228*

3. Location difference in chemical composition.

Considerable difference by location in the content of nutrients including Ca and P was observed for given species of native herbages studied. The same trend was also found in the mean chemical composition of native grasses and legumes

4. Family difference in the content of nutrients

In general, the concentration of crude protein and Ca was much higher for legumes and shrubs than for grasses and *carduaceae*. In the content of crude fiber, grass was much higher than legumes, shrubs and *carduceae*.

5. Burning effect on the chemical composition

Crude protein content during the initial stage of growth was markedly increased by burning old grasses for both grass and legume family during the preceding month of budding. Burning could also increase crude ash content of grasses for all stages of growing.

6. Relationship between crude protein content and crude fiber content.

An inverse relationship between the crude protein content and crude fiber content was found as was described by following regression equations (where X=crude protein content %, Y=crude fiber content %).

Family	Regression equations	Syx	r^2
Grass	$Y=41.87-0.78X$	0.160	0.465**
Legume	$Y=46.54-1.190X$	0.363	0.491**

7. Digestion coefficients and digestible nutrients.

From the results of digestion trials with 14 individual species and 7 mixed native grasses, it was found that the content of DCP and TDN for *Eragrostis ferruginea*, *Digitaria sanguinalis* and *Phragmites prosturatus* of the grass family; for *Pueraria thunbergiana*, *Securinega subfruticosa* and *Lespedeza spp.* of legume family; for *Robinia pseudo acacia* and *Betula plastyphylla* of shrubs was relatively higher than others. The content of DCP and TDN for mixed grasses from paddy areas was higher than those from mountain areas.

8. Effect of maturity stage on nutrient digestibility.

Digestibility of nutrients including DM and energy in individual native herbage species was significantly depressed as the growing stage progressed from August to September.

The digestion coefficients of crude protein and crude fat for the mixed grass hay harvested in August were higher than those harvested in June. Digestibilities were depressed markedly for the mixed grasses harvested in October. The digestion coefficient of crude fiber changed in opposite manner to that of crude protein. The magnitude of depression in digestibility of DM and energy of individual native herbage species was higher than that of mixed native grasses. The DCP content of native grasses harvested was higher during the period of August.

Dry matter digestibility of samples collected from Songhwan area determined by *in vitro* method was decreased as the stage of maturity advanced.

9. Digestibility difference between green materials and dried materials.

Digestibility data obtained from 7 grasses, 3 legumes and 4 shrubs revealed that digestibility of nutrients and the amount of digestible nutrients were much lower for hay than green materials. The digestibility depression of hay was more severe for legumes than grasses.

10. Relationship between DDM and TDN or DE

There was a straight linear relationship between DDM and TDN or DE of grasses, legumes and mixed grasses. It appears that the equations may be used to estimate the content of TDN or DE from DDM, since the error attached to the estimate is relatively small. The statistics related to this relationship are summarized as follows (where, X=DDM%, Y=TDN or DE%)

Family	TDN or DE	Regression equation	Sy.x	r^2
Grass	TDN	Y=1.10X−6.31	0.264	0.974**
	DE	Y=0.964X+1.38	0.270	0.850**
Legume	TDN	Y=0.965X−0.18	0.290	0.918**
	DE	Y=1.150X−10.52	0.348	0.845**
Mixed grass	TDN	Y=0.976X−0.36	0.161	0.970**
	DE	Y=0.888X+4.96	0.174	0.677**

11. Effect of fertilizer application on the chemical composition.

The content of crude protein and phosphorus of native herbage species was considerably increased by fertilizer application. Fertilizer application could also decrease the crude fiber content of native grasses.

12. Effect of fertilizer application on digestibility.

Although the degree of effect of fertilizer application on nutrient digestibility was somewhat smaller than on chemical composition, fertilizer application could improve the digestibility of nutrients.

13. Conclusion Remark.

From the above results it is apparent that the crude protein content of the native pasture species studied is usually above the level of 7% which is considered the minimum maintenance requirement for a dry cow, however, the crude fiber content was also high and could account for the low dry matter digestibilities. It would be concluded that insufficient intake of energy would be the main factor limiting animal production.

Since the length of the growing season of native herbage plants is only 5 months (June to October), it would be necessary to harvest the native pasture species in August or September to make hay or ensilage.

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List of Tables

Table 1. Name of collected native herbage plants 4
Table 2. Chemical composition of some native herbage plants (green) 7
Table 3. Effect of stage of maturity on chemical composition of some native herbage plants (DM).....13
Table 4. Effect of stage of maturity on Ca and P content 20
Table 5. Seasonal changes in chemical composition of mixed native herbage plants (DM) 21
Table 6. Location difference in chemical composition of some native herbage plants 22
Table 7. Location difference in mean chemical composition of native herbage plants 27
Table 8. Location difference in mean chemical composition of mixed grasses 28
Table 9. Family difference in content of nutrients (DM).....28
Table 10. Burning effect in chemical composition of native herbage 29
Table 11. Effect of burning and stage of growth on mean chemical composition of some native herbage plants.....31
Table 12. Digestibility and digestion coefficients of some native herbage plants 32
Table 13. Effect of stage of maturity on digestible nutrients of some native herbage plants 36
Table 14. Effect of location and stage of growth on digestible nutrients of mixed grasses.....37
Table 15. Seasonal changes of DM digestibility of some native herbage plants determined by *in vitro* 39
Table 16. Digestible nutrient content and digestion coefficients of green material and hay of native herbage plants.....40
Table 17. Effect of fertilizer application on the chemical composition of mixed native grasses and Italian rye grass 42
Table 18. Effect of fertilizer application on the nutrient digestibility of mixed native grasses and Italian rye grass.....43

List of Figures

Figure 1. Seasonal changes in crude protein (mean of 1969).....20
Figure 2. Seasonly changes in crude fiber (mean of 1969).....20
Figure 3. Relationship between stage of maturity and crude protein content.....22
Figure 4. Relationship between stage of maturity and crude fiber content 22
Figure 5. Burning effect on the crude protein content of native herbage harvested on different growing stage.....31
Figure 6. Burning effect on the crude fiber content of native herbages harvested on different growing stage.....31
Figure 7. Relationship between crude protein and crude fiber content of native herbage plants 31
Figure 8. Relationship between DDM and TDN or DE in grasses 40
Figure 9. Relationship between DDM and TDN or DE in legumes and other families 40
Figure 10. Relationship between DDM and TDN or DE in mixed herbage plants.....41

Appendix 1. Chemical composition of hay of native plants(1968)

Location	Family	Species	Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE
			%	%	%	%	%	%
Yongin and Suwon	Grass	*Miscanthus purpurascens*	9.71	10.86	1.04	30.00	4.46	43.93
		Phragmites prosturatus	8.05	7.03	1.74	22.96	12.88	47.34
		Eragrostis ferruginea	10.23	6.40	0.96	27.60	5.51	49.30
		Calamagrostis arundinacea	10.18	5.64	1.37	30.15	5.11	47.55
		Agropyrum semicostum	10.26	4.31	1.28	29.09	4.15	50.91
		Digitaria sanguinalis	10.47	7.51	1.47	25.97	6.98	47.60
		Zijania caduciflora	9.12	8.07	1.60	26.84	6.72	47.65
	Legume	*Lespedeza spp.*	9.69	8.36	3.20	30.84	2.87	45.04
		Pueraria thumbergiana	11.57	11.34	1.04	28.70	5.84	41.51
		Sacurineqa subfruticosa	10.35	7.04	2.92	25.37	5.14	49.18
	Shrub	*Robinia pseudo acacia*	10.73	18.24	2.67	14.97	5.22	48.17
		Salix glandulosa	10.87	8.80	1.51	24.77	4.77	49.28
		Quercus dentata	10.80	9.88	1.69	25.46	3.40	48.77
		Betula platyphylla	7.31	16.72	2.17	27.55	5.44	40.81
	Others	Mixed grasses	9.30	10.44	1.66	27.66	9.45	42.09
		Mixed grasses	8.56	5.62	1.24	30.69	5.57	48.32
Daekwannyung		Mixed grasses	11.32	8.52	1.54	30.54	5.27	42.81
Jinju	Grass	*Digitaria sanguinalis*	11.03	12.92	2.55	24.43	9.48	39.59
		Chloris virgata	10.34	11.36	2.68	27.15	11.16	37.91
		Setaria viridis	10.52	9.47	1.86	43.19	10.79	24.17
		Eleusine indica	11.41	8.05	1.92	26.05	7.91	44.66
		Setaria lutescens	11.86	8.73	1.16	33.43	10.41	34.41
		Arthraxon hispidus	10.79	9.64	1.71	31.13	13.20	33.53
		Imperata cylindrica	11.63	5.22	0.82	30.22	4.16	47.95
		Spodiopogon sibiricus	12.03	6.34	0.82	31.80	4.61	41.40
		Eocoilopus cotulifer	13.71	7.32	0.90	32.83	5.38	39.86
		Miscanthus purpurascens	12.12	9.62	1.15	24.77	6.36	45.98
		Phacelurus angustifolia	12.14	7.05	1.13	25.88	5.88	47.92
		Arundinella hirta	12.30	3.72	1.10	28.61	3.80	50.47
		Themeda japonica	10.74	4.68	1.10	32.11	4.10	47.33
		Cymobopogon goeringii	10.04	4.97	2.52	33.21	3.17	46.09
		Holcus fulvus	10.60	4.23	1.95	31.20	6.02	46.00
		Eragrostis ferruginea	10.27	8.16	1.87	30.37	5.47	43.86
		Eulia speciosa	9.97	4.36	2.18	33.57	4.02	45.90
		Phragmites prosturatus	10.26	13.52	1.91	31.47	6.96	35.78
		Calamagrostis arundinacea	10.22	9.90	2.10	43.08	6.42	28.28
		Phalaris arundinacea	12.42	15.70	1.14	32.21	12.83	25.70
	Legume	*Lespedeza striata*	11.35	14.80	2.65	27.36	6.95	36.87
		Aeschynomene indica	12.34	16.82	2.40	20.95	4.40	43.09
Jeju	Grass	*Imperata cylindrica*	10.62	5.03	1.46	28.95	3.63	50.30
		Cymbopogon goeringii	10.50	4.78	2.95	28.06	3.97	49.72
		Miscanthus purpurascens	9.71	4.51	1.53	29.16	3.39	51.60

Location	Family	Species	Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE
			%	%	%	%	%	%
	Legume	*Lespedeza bicolor*	12.14	10.64	2.56	29.74	3.62	41.28
		Dunbaria villosa	10.38	14.03	3.75	23.44	3.84	44.54
		Lespedeza cuneata	11.81	11.58	1.96	28.74	3.35	42.53
		Indigofera koreana	12.15	14.57	3.76	19.37	4.86	45.28
		Cassia nomame	12.63	12.32	2.96	20.75	3.66	45.57
		Pueraria thunbergiana	11.37	15.37	2.21	24.45	5.28	36.31
	Carduaceae	*Artemisia asiatica*	10.55	7.11	2.00	24.39	5.14	50.79

Appendix 2. Chemical compossition of native herbage plants(1969)

Location	Species	Month	Air dry basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P	Green basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
Daekwan-nyung	*Lophatherum eratum*	June	13.0	5.4	1.0	32.1	5.8	42.8	0.11	0.06	45.3	3.4	0.6	20.2	3.6	26.9	0.07	0.04
		Aug.	12.7	6.5	1.3	34.5	6.9	38.2	0.10	0.06	47.5	3.9	0.7	20.7	4.1	22.9	0.06	0.04
		Oct.	13.4	6.0	1.4	31.0	6.2	42.0	0.11	0.05	65.0	2.4	0.6	12.5	2.5	17.0	0.05	0.02
	Themeda japonica	June	13.6	5.2	2.4	19.9	13.2	45.7	0.87	0.10	62.3	2.3	1.1	8.7	5.8	19.9	0.38	0.04
		Aug.	12.3	7.1	1.6	23.8	14.7	48.6	0 92	0.12	74.1	2.1	0.5	7.0	4.3	12.0	0.27	0.04
		Oct.	12.9	8.0	2.0	20.4	12.8	43.9	0.96	0.15	57.0	3.9	1.0	10.1	6.3	21.7	0.47	0.07
	Festuca rubra	June	12.9	6.9	1.7	26.5	3.8	48.2	0.24	0.06	59.7	3.2	0.8	12.3	1.7	22.3	0.11	0.03
		Aug.	13.6	8.1	2.3	32.1	7.2	36.7	0.32	0.10	73.5	2.5	0.7	9.8	2.2	11.3	0.10	0.03
		Oct.	13.4	6.6	1.8	32.5	6.0	39.6	0.27	0.08	20.0	6.1	1.7	30.0	5.6	36.6	0.25	0.07
	Miscanthus purpurascens	June	12.5	8.3	2.1	32.1	5.2	39.9	0.21	0.15	73.3	2.5	0.7	9.8	1.6	12.2	0.06	0.05
		Aug.	12.4	6.3	1.8	35.6	4.5	39.5	0.29	0.11	63.1	2.6	0.7	15.0	1.9	16.6	0.12	0.04
		Oct.	13.1	2.4	0.4	37.3	4.2	42.6	0.15	0.02	—	—	—	—	—	—	—	—
	Arundinella hirta	June	13.4	7.1	1.7	29.9	4.5	43.7	0.30	0.11	73.0	2.2	0.4	9.3	1.4	13.6	0.09	0.04
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	12.8	2.7	0.6	39.1	2.3	42.5	0.15	0.03	—	—	—	—	—	—	—	—
	Eccoilopus cotulifer	June	12.8	7.0	1.4	33.1	4.4	41.4	0.24	0.10	67.7	2.6	0.5	12.3	1.6	15.4	0.09	0.04
		Aug.	12.6	6.3	0.6	34.1	4.4	41.7	0.43	0.10	65.3	2.5	0.4	13.5	1.8	16.1	0.17	0.04
		Oct.	13.0	6.7	0.4	35.3	4.3	40.3	0.39	0.03	—	—	—	—	—	—	—	—
	Viciaamoena fischer	June.	12.0	17.1	1.3	38.2	5.4	25.9	0.79	0.15	72.8	5.3	0.4	11.88	1.7	8.0	0.24	0.05
		Aug.	13.0	14.9	0.8	39.7	4.8	26.8	1.04	0.15	70.1	5.1	0.3	13.1	1.6	9.2	0.36	0.05
		Oct.	12.9	5.9	0.3	51.0	3.1	26.9	0.73	0.03	—	—	—	—	—	—	—	—
	Vicia saxajuga	June	13.1	15.7	1.9	31.4	5.5	32.3	1.12	0.16	73.9	4.7	0.6	9.4	1.7	9.7	0.34	0.05
		Aug.	13.1	11.7	2.3	33.9	3.4	35.7	1.01	0.12	66.4	4.5	0.9	13.1	1.3	13.8	0.39	0.05
		Oct.	13.3	8.6	0.1	40.5	2.6	34.9	0.94	0.07	—	—	—	—	—	—	—	—
	Thalictrum aquilegifolium	June	13.2	13.6	1.6	26.9	5.3	39.4	1.01	0.17	72.7	4.3	0.5	8.5	1.7	12.4	0.32	0.05
		Aug.	13.0	5.6	0.9	31.1	4.1	45.4	1.23	0.09	61.0	2.5	0.9	13.9	1.8	20.4	0.55	0.04
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	Species	Month	Air dry basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P	Green basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
	Lespedeza striata	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	12.8	17.2	1.8	28.3	5.5	34.4	0.93	0.24	76.5	4.6	0.5	7.6	1.5	9.3	0.25	0.06
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Solidago virgaurea	June	12.4	12.4	1.2	25.5	8.6	40.1	1.43	0.21	—	—	—	—	—	—	—	—
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Artemisia asiatica	June	13.2	18.1	2.0	21.5	8.4	36.8	0.76	0.30	78.1	4.6	0.5	5.4	2.1	9.3	0.19	0.07
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Juncus brachyspathus	June	12.9	8.1	1.9	29.9	8.0	39.2	0.27	0.12	72.7	2.6	0.6	9.6	2.5	12.5	0.09	0.04
		Aug.	12.8	9.9	0.1	31.0	12.0	33.7	0.33	0.14	77.4	2.6	0.2	8.0	3.1	8.7	0.09	0.04
		Oct.	13.3	3.6	0.3	34.5	9.3	39.6	0.08	0.03	—	—	—	—	—	—	—	—
	Hemerocallis aurantiaca	June	12.7	8.3	2.1	21.2	6.9	49.0	0.45	0.10	—	—	—	—	—	—	—	—
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	13.0	5.3	1.7	30.0	6.5	43.6	0.80	0.04	—	—	—	—	—	—	—	—
	Carex lanceolata	June	12.4	7.8	1.9	27.2	4.0	46.7	0.22	0.06	56.4	3.9	1.0	13.6	2.0	23.2	0.11	0.03
		Aug.	12.6	6.6	1.0	32.5	4.6	42.7	0.31	0.08	55.8	3.3	0.5	16.5	2.4	21.6	0.15	0.04
		Oct.	12.9	5.7	1.7	31.4	4.9	43.4	0.14	0.06	20.0	5.3	1.5	28.8	4.5	39.9	0.22	0.05
	Convallaria keiskei	June	12.9	9.8	3.3	22.1	7.4	44.6	1.14	0.14	76.8	2.6	0.9	5.9	2.0	11.9	0.30	0.04
		Aug.	12.6	8.4	3.7	28.2	10.1	37.1	1.67	0.13	82.5	1.7	0.7	5.6	1.0	7.4	0.53	0.03
		Oct.	13.1	4.7	3.2	37.2	4.8	37.0	2.20	0.06	—	—	—	—	—	—	—	—
	Aster scaber	June	13.4	12.1	3.7	20.0	10.4	40.5	1.36	0.11	25.5	2.0	0.6	3.4	1.7	6.8	0.23	0.02
		Aug.	13.0	9.0	4.9	25.7	8.4	39.0	1.33	0.10	79.8	2.1	1.1	6.0	2.0	9.1	0.31	0.02
		Oct.	12.8	8.6	4.3	24.0	5.0	48.3	2.11	0.05	—	—	—	—	—	—	—	—
	Juncus castaneus	June	13.6	10.0	1.9	26.8	6.6	41.1	0.24	0.13	74.4	3.0	0.6	8.0	2.0	12.2	0.07	0.04
		Aug.	12.9	11.4	2.0	30.0	10.0	33.8	0.29	0.13	78.5	2.8	0.5	7.4	2.5	8.4	0.07	0.03
		Oct.	13.0	5.7	0.6	31.6	10.7	38.3	0.13	0.06	20.0	5.3	0.5	29.6	9.9	25.2	0.12	0.06
	Artemisia sylvatica	June	13.4	6.0	2.4	37.9	5.2	45.1	0.54	0.15	67.9	2.2	0.9	10.4	1.9	16.7	0.20	0.05

Location	Species	Month	Air dry basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P	Green basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
		Aug.	12.9	7.5	1.2	33.5	5.4	39.5	0.75	0.18	62.9	3.2	0.5	14.3	2.3	16.8	0.32	0.08
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Astilbe chinensis	June	12.6	11.7	2.2	24.2	4.8	44.6	1.13	0.16	78.6	2.9	0.5	0.9	1.2	10.9	0.28	0.04
		Aug.	12.4	5.8	3.0	30.4	4.8	43.6	1.38	0.17	72.3	1.9	1.0	9.6	1.5	13.8	0.44	0.05
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cirsium sen. dens	June	13.2	11.1	2.5	23.1	12.0	38.1	2.79	0.12	83.1	2.7	0.5	4.5	2.3	7.4	0.54	0.02
		Aug.	13.3	7.1	3.7	31.2	7.1	37.7	2.31	0.10	76.3	2.0	1.0	8.5	1.9	10.3	0.43	0.03
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Artemisia asiatica	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	13.2	14.8	3.0	28.5	7.9	33.4	0.80	0.26	77.0	3.9	0.8	7.6	1.9	8.9	0.21	0.07
		Oct.	12.6	4.0	1.9	36.1	3.9	41.6	0.59	0.08	20.0	3.7	1.7	33.0	3.6	38.0	0.54	0.07
Jirisan	*Pennisetum japonica*	June	13.0	10.1	2.6	26.5	5.2	42.6	0.29	0.17	—	—	—	—	—	—	—	—
		Aug.	12.6	8.1	1.7	30.4	7.3	40.1	0.24	0.18	75.0	2.3	0.5	8.7	2.1	11.5	0.07	0.05
		Oct.	12.9	3.9	0.8	34.9	5.7	41.9	0.30	0.10	72.0	1.3	0.3	11.2	1.8	13.5	0.10	0.03
	Miscanthus sinensis	June	12.6	9.9	1.0	32.1	5.9	38.5	0.29	0.16	—	—	—	—	—	—	—	—
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Eulia speciosa	June	13.3	10.9	2.5	28.2	7.0	38.1	0.21	0.12	—	—	—	—	—	—	—	—
		Aug	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Themeda japonica	June	12.4	6.6	1.7	31.9	5.6	41.9	0.21	0.10	—	—	—	—	—	—	—	—
		Aug.	13.1	5.3	1.3	38.1	4.7	37.5	0.23	0.09	70.0	1.8	0.5	13.7	1.6	12.9	0.08	0.03
		Oct.	13.3	3.3	0.9	33.1	4.4	45.0	0.16	0.05	62.0	1.4	0.4	14.5	1.9	19.7	0.07	0.02
	Imperata cylindrica	June	12.9	6.1	1.5	31.2	3.9	44.4	0.23	0.10	—	—	—	—	—	—	—	—
		Aug.	13.4	5.2	1.9	27.5	3.5	48.6	0.25	0.10	62.0	2.3	0.8	12.1	1.6	21.3	0.11	0.05
		Oct.	13.7	3.1	1.3	29.8	4.2	47.9	0.22	0.04	75.0	0.9	0.4	8.6	1.2	13.9	0.06	0.01
	Agropyrum semicostum	June	13.0	8.1	1.4	28.3	4.6	44.6	0.23	0.15	—	—	—	—	—	—	—	—
		Aug	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	Species	Month	Air dry basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P	Green basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Eragrostis ferruginea	June	13.4	10.3	2.6	26.3	5.2	42.3	0.26	0.21	—	—	—	—	—	—	—	—
		Aug.	13.5	6.9	1.9	31.7	5.0	41.1	0.20	0.08	60.0	3.2	0.9	14.6	2.3	19.0	0.09	0.04
		Oct.	12.9	4.4	1.2	31.1	4.7	45.8	0.19	0.16	45.0	2.8	0.7	19.6	3.0	28.9	0.12	0.10
	Eccoilopus cotulifer	June	12.6	7.4	1.5	29.8	5.4	43.5	0.32	0.13	—	—	—	—	—	—	—	—
		Aug.	13.1	6.0	1.8	34.7	4.8	39.7	0.30	0.10	70.0	2.1	0.6	12.0	1.6	13.7	0.10	0.36
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Phragmites prosturatus	June	13.3	14.7	1.8	30.5	10.1	29.6	0.19	0.17	—	—	—	—	—	—	—	—
		Aug.	12.6	10.6	1.6	28.2	11.0	36.0	0.16	0.07	60.0	4.9	0.7	12.9	5.1	16.5	0.07	0.03
		Oct.	12.4	11.1	1.8	24.7	12.4	37.7	0.18	0.10	55.0	5.7	0.9	12.7	6.4	19.4	0.09	0.05
	Arundinella hirta	June	12.3	6.5	2.8	32.0	4.0	42.5	0.26	0.10	—	—	—	—	—	—	—	—
		Aug.	13.1	4.2	1.2	34.9	4.0	42.5	0.27	0.19	65.0	1.7	0.5	14.1	1.6	17.1	0.11	0.08
		Oct.	12.7	3.3	0.6	33.4	3.8	46.1	0.18	0.05	52.0	1.8	0.3	18.4	2.1	25.3	0.10	0.03
	Digitaria sanguinalis	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	12.8	8.2	3.6	26.3	8.1	41.0	0.28	0.38	80.0	1.9	0.8	6.0	1.9	9.4	0.06	0.09
		Oct.	13.0	5.9	1.0	31.0	6.6	42.5	0.30	0.21	80.0	1.3	0.2	7.1	1.5	9.8	0.07	0.05
	Miscanthus purpurascens	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	13.6	5.1	1.9	35.5	4.9	39.0	0.16	0.10	60.0	2.4	0.9	16.4	2.3	18.1	0.08	0.04
		Oct.	13.4	4.1	1.4	33.9	4.4	42.9	0.19	0.07	56.0	2.1	0.7	17.2	2.2	21.8	0.10	0.04
	Paspalum thunbergii	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug	13.7	7.5	1.8	33.4	6.5	37.1	0.24	0.15	80.0	1.8	0.4	7.7	1.5	8.6	0.06	0.03
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Calamagrostis arundinacea	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	13.6	8.5	2.2	33.2	9.4	33.1	0.16	0.07	69.0	3.0	0.8	11.9	3.4	11.9	0.06	0.02
		Oct.	12.9	4.7	1.3	35.5	7.8	37.8	0.10	0.06	60.0	2.2	0.6	16.3	3.5	17.4	0.05	0.03
	Cymbopogon goeringii	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	13.9	5.1	2.4	33.8	5.1	39.8	0.22	0.10	67.0	2.0	0.9	12.9	1.9	15.3	0.08	0.04
		Oct.	12.9	5.0	3.4	31.5	3.4	43.9	0.16	0.06	49.0	2.9	2.0	18.4	2.0	25.7	0.09	0.06

Location	Species	Month	Air dry basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P	Green basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
	Spodiopogon sibiricus	June.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	13.4	4.2	1.0	31.9	4.8	44.7	0.61	0.08	70.0	1.5	0.3	11.0	1.7	15.5	0.21	0.03
	Lespedeza cuneata	June	13.4	12.5	2.2	23.5	4.7	43.8	0.90	0.04	—	—	—	—	—	—	—	—
		Aug.	13.9	11.0	1.7	31.3	3.2	39.0	0.74	0.11	60.0	5.1	0.8	14.5	1.5	18.1	0.34	0.05
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Pueraria thunbergiana	June	12.7	21.5	3.0	22.0	8.2	32.6	1.63	0.10	—	—	—	—	—	—	—	—
		Aug.	13.2	11.0	1.8	35.4	5.3	33.3	1.04	0.08	79.0	2.7	0.4	8.6	1.3	8.1	0.25	0.02
		Oct.	12.6	13.2	2.2	25.9	6.1	40.0	1.55	0.13	65.0	5.3	0.9	10.4	0.5	16.0	0.62	0.05
	Lespedaza spp.	June	13.3	16.3	3.4	21.5	3.4	42.1	0.59	0.15	—	—	—	—	—	—	—	—
		Aug.	12.6	11.5	2.5	28.6	3.7	41.2	0.77	0.37	70.0	3.9	0.8	9.8	1.3	13.1	0.26	0.13
		Oct.	12.9	9.0	3.7	29.2	2.9	42.4	1.00	0.08	68.0	3.3	1.4	10.7	1.1	15.6	0.37	0.03
	Artemisia asiatica	June	13.0	23.9	3.5	15.9	10.2	33.5	0.72	0.19	—	—	—	—	—	—	—	—
		Aug.	12.9	10.0	2.5	29.6	6.7	38.2	0.67	0.20	70.0	3.5	0.9	10.2	2.3	13.2	0.20	0.07
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Yongin	*Festuca ovina*	June	13.2	6.5	2.8	25.7	4.5	47.3	0.22	0.07	56.8	3.3	1.4	12.8	2.2	23.5	0.11	0.03
		Aug.	13.0	5.9	1.6	32.3	5.4	41.8	0.26	0.07	58.7	2.8	0.8	15.3	2.6	19.8	0.12	0.03
		Oct.	13.3	5.1	1.9	31.7	4.5	43.6	0.16	0.06	35.3	3.8	1.4	23.7	3.4	32.5	0.12	0.05
	Calamagrostis arundinacea	June	12.6	6.6	2.6	28.5	6.4	43.4	0.23	0.08	60.8	3.0	1.2	12.8	2.9	19.5	0.10	0.04
		Aug.	12.7	7.2	2.1	34.9	10.3	32.9	0.21	0.09	65.8	2.8	0.8	13.7	4.0	12.9	0.08	0.03
		Oct.	12.4	5.0	1.5	34.1	5.5	41.5	0.19	0.04	47.7	3.0	0.9	20.4	3.3	24.8	0.12	0.03
	Cymbopogon goeringii	June	14.1	6.4	4.1	23.3	4.5	47.8	0.38	0.07	65.8	2.5	1.6	9.0	1.7	18.5	0.15	0.03
		Aug.	13.3	4.8	2.9	36.7	5.3	37.0	0.28	0.06	64.5	2.0	1.2	15.1	2.2	15.2	0.11	0.02
		Oct.	13.5	3.9	2.2	35.2	3.5	41.8	0.11	0.03	38.9	2.7	1.54	24.9	2.5	29.5	0.08	0.02
	Phragmites prosturatus	June	12.5	16.4	2.8	21.0	12.9	34.5	0.19	0.17	75.1	4.6	0.8	6.0	3.7	9.8	0.05	0.05
		Aug.	12.1	16.5	2.4	25.3	12.4	31.4	0.19	0.18	69.6	5.7	0.8	8.8	4.3	10.8	0.07	0.06
		Oct.	12.3	10.6	0.8	24.9	12.3	39.0	0.15	0.10	58.4	5.0	0.4	11.7	5.9	18.5	0.07	0.05

Location	Species	Month	Air dry basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P	Green basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
	Miscanthus purpurascens	June	13.1	5.1	1.7	28.0	6.1	46.0	0.15	0.08	67.8	1.9	0.6	10.4	2.3	17.1	0.05	0.03
		Aug.	12.9	2.9	1.1	36.9	3.6	42.5	0.42	0.08	58.0	1.4	0.5	17.8	1.8	20.6	0.20	0.04
		Oct.	12.6	2.5	0.7	31.5	3.9	46.0	0.18	0.03	42.6	1.6	0.4	22.6	2.5	30.2	0.12	0.02
	Themeda japonica	June	12.8	5.9	1.6	28.1	6.2	45.5	0.17	0.07	67.1	2.2	0.6	10.6	2.3	17.2	0.07	0.04
		Aug.	13.1	3.6	1.1	37.3	4.5	40.4	0.17	0.04	54.9	1.9	0.6	19.4	2.3	21.0	0.09	0.02
		Oct.	13.6	1.7	2.3	36.7	5.3	41.4	0.13	0.03	24.4	1.5	2.0	31.7	4.5	35.9	0.12	0.02
	Arundinella hirta	June	12.8	4.3	1.8	28.6	3.4	49.1	0.33	0.06	67.0	1.6	0.1	10.8	1.3	18.6	0.13	0.02
		Aug.	12.6	3.3	0.8	36.4	4.0	43.0	0.20	0.04	61.6	1.5	0.4	16.0	1.7	18.9	0.09	0.02
		Oct.	13.1	2.1	0.2	33.7	4.0	46.9	0.19	0.03	41.9	1.4	0.2	22.5	2.7	31.3	0.13	0.02
	Eragrostis ferruginea	June	12.7	8.3	2.8	27.0	4.6	44.5	0.20	0.24	64.4	3.4	1.2	11.0	1.9	18.7	0.08	0.10
		Aug.	12.4	9.3	1.9	30.7	5.9	39.7	0.24	0.29	65.8	3.6	0.8	12.0	2.3	15.5	0.09	0.11
		Oct.	12.6	6.6	1.2	28.9	5.4	45.4	0.24	0.22	29.7	5.3	1.0	23.2	4.3	36.5	0.18	0.18
	Zoysia japonica	June	12.4	5.3	2.5	27.3	5.2	47.3	0.20	0.18	60.0	2.4	1.1	12.5	2.9	21.6	0.09	0.08
		Aug.	12.3	6.3	1.6	30.6	4.4	44.8	0.21	0.14	54.0	3.3	0.8	16.0	2.3	23.5	0.11	0.07
		Oct.	13.0	5.7	1.1	30.7	7.8	41.7	0.33	0.32	28.1	4.7	0.9	25.4	6.4	34.5	0.27	0.27
	Calamagrostis arundinacea	June	12.2	6.4	2.3	29.4	4.4	45.2	0.45	0.13	68.8	2.3	0.8	10.5	1.6	16.1	0.16	0.05
		Aug.	12.3	4.5	1.3	35.9	3.9	41.9	0.11	0.04	62.3	2.1	0.5	15.4	1.7	18.0	0.05	0.02
		Oct.	12.0	2.1	0.3	26.1	4.5	55.0	0.33	0.03	37.0	1.5	0.2	18.7	3.2	39.4	0.24	0.02
	Amorpha fructicosa	June	12.3	17.9	3.6	14.6	3.3	49.2	0.81	0.13	73.8	5.1	1.1	4.4	1.0	14.7	0.24	0.04
		Aug.	13.3	10.9	2.9	24.7	4.0	44.2	1.49	0.08	66.5	4.2	1.1	9.5	1.6	17.1	0.58	0.03
		Oct.	13.1	7.2	1.3	34.7	3.5	40.4	1.40	0.05	50.8	4.1	0.7	19.6	2.0	22.9	0.79	0.03
	Astragalus membranaceus	June	13.0	16.2	3.0	14.0	4.4	49.4	1.45	0.15	69.0	5.8	1.1	5.0	1.6	17.6	0.52	0.05
		Aug.	13.2	11.6	2.7	23.4	6.3	42.9	0.94	0.09	59.9	5.4	1.2	10.8	2.9	19.8	0.43	0.04
		Oct.	12.6	5.7	0.9	33.8	3.6	43.5	1.51	0.03	17.7	5.4	0.8	31.8	3.4	40.9	1.42	0.02
	Securinega subfruticosa	June	12.6	16.1	3.5	17.7	6.5	43.7	6.48	0.24	71.0	5.3	1.2	5.9	2.2	14.5	0.41	0.08
		Aug.	13.0	17.1	2.5	24.9	4.5	38.0	0.95	0.16	62.2	7.4	1.1	10.8	2.0	16.5	0.41	0.07
		Oct.	13.7	11.7	2.9	28.8	4.3	39.6	1.36	0.07	59.8	5.4	1.3	13.3	2.0	18.3	0.63	0.03
	Pueraria thunbergiana	June	13.1	14.8	2.4	24.8	5.7	39.2	0.99	0.12	73.1	4.6	0.7	7.7	1.8	12.2	0.31	0.04

Location	Species	Month	Air dry basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P	Green basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
		Aug.	12.6	11.2	2.5	32.6	4.9	36.3	1.19	0.08	65.1	4.5	1.0	13.0	1.9	14.5	0.48	0.03
		Oct.	12.3	8.3	1.2	35.3	4.4	38.5	1.19	0.06	62.3	3.5	0.5	15.2	1.9	16.5	0.51	0.03
	Artemisia japonica	June	12.9	9.1	3.7	13.1	7.8	53.4	1.05	0.14	72.3	2.9	1.2	4.2	2.5	17.0	0.33	0.04
		Aug.	13.2	7.7	2.5	30.2	5.9	40.6	0.10	0.15	69.2	2.7	0.9	10.7	2.1	14.4	0.04	0.05
		Oct.	13.2	6.5	2.2	21.8	7.0	49.3	1.37	0.09	68.3	2.4	0.8	8.0	2.6	18.0	0.50	0.03
	Artemisia asiatica	June	12.7	12.8	4.1	14.8	7.7	47.9	0.67	0.24	71.8	4.1	1.3	4.8	2.5	15.5	0.22	0.08
		Aug.	12.7	12.8	3.3	26.2	6.7	38.6	0.80	0.27	73.6	3.9	1.0	7.9	2.0	11.7	0.24	0.08
		Oct.	13.0	13.0	2.6	22.9	6.7	41.8	0.89	0.21	53.9	6.9	1.4	12.1	3.5	22.1	0.42	0.11
	Betula platyphylla	June	13.2	21.8	4.0	17.5	4.7	38.9	0.69	0.19	72.9	6.8	1.3	5.5	1.5	12.1	0.21	0.06
		Aug.	13.3	14.3	2.7	26.9	2.9	40.0	0.75	0.10	61.5	6.7	1.2	11.9	1.3	17.8	0.34	0.05
		Oct.	13.1	12.8	2.0	21.5	2.6	47.9	0.87	0.10	58.2	6.2	1.0	10.4	1.3	23.1	0.42	0.05
	Lespedeza spp.	June	12.6	14.5	4.7	22.9	3.3	42.0	0.85	0.10	64.5	5.9	1.9	9.3	1.4	17.1	0.35	0.04
		Aug.	13.2	10.4	4.9	23.7	3.1	44.7	0.82	0.07	57.8	5.1	2.9	11.5	1.5	21.7	0.40	0.04
		Oct.	13.1	7.7	0.5	27.1	3.2	48.9	1.12	0.05	53.6	4.1	0.3	14.5	1.7	25.8	0.60	0.04
Andong	*Miscanthus purpurascens*	June	13.1	8.0	0.9	28.4	4.9	44.7	0.37	0.14	62.0	3.5	0.4	12.4	2.2	19.6	0.16	0.06
		Aug.	12.8	6.0	1.4	35.7	4.3	39.9	0.27	0.16	60.0	2.7	0.6	16.4	2.9	18.3	0.12	0.07
		Oct.	13.7	6.3	0.7	32.5	4.5	42.4	0.34	0.15	50.0	3.6	0.4	18.8	2.6	24.6	0.20	0.09
	Arundinella hirta	June	13.4	5.2	1.2	26.2	5.4	48.6	0.36	0.10	65.0	2.1	0.5	10.6	2.2	19.6	0.15	0.04
		Aug.	13.3	6.3	1.3	35.2	4.5	39.4	0.29	0.20	60.0	2.9	0.6	16.2	2.1	18.2	0.14	0.09
		Oct.	13.6	6.9	1.5	31.2	6.9	40.0	0.37	0.11	50.0	4.0	0.9	16.1	4.9	23.1	0.22	0.07
	Eulia speciosa	June	12.9	7.0	2.0	23.4	5.8	48.9	0.43	0.11	53.0	3.8	0.1	12.6	3.1	26.4	0.23	0.06
		Aug.	12.7	6.1	1.6	31.9	5.9	41.8	0.35	0.17	65.0	2.5	0.6	12.8	2.4	16.7	0.14	0.07
		Oct.	12.8	5.8	1.0	30.9	5.1	44.4	0.35	0.14	45.0	3.7	0.6	19.5	3.2	28.0	0.22	0.09
	Themeda japonica	June	13.0	3.6	0.9	29.1	4.9	48.5	0.21	0.11	68.0	1.7	0.4	13.4	2.2	22.3	0.11	0.05
		Aug.	12.7	4.3	1.0	35.5	4.0	42.6	0.23	0.12	65.0	1.7	0.4	14.2	1.6	17.1	0.09	0.05
		Oct.	13.0	2.7	0.8	31.9	4.9	46.1	0.20	0.09	60.0	1.3	0.4	14.8	2.2	21.4	0.09	0.04
	Cymbopogon goeringii	June	13.4	7.0	1.5	26.8	4.9	46.4	0.27	0.07	74.0	2.1	0.4	8.0	1.5	13.9	0.08	0.02
		Aug.	13.1	4.9	1.8	30.2	5.8	41.2	0.36	0.06	62.0	2.1	0.8	13.2	2.5	19.3	0.16	0.06

Location	Species	Month	Air dry basis (%) Moisture	C. Prot.	C. Fat	C. Fab.	C. Ash	NFE	Ca	P	Green basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
		Oct.	13.2	3.7	2.4	30.0	5.3	45.4	0.23	0.21	40.0	2.5	1.6	20.8	3.7	31.4	0.16	0.04
	Eccoilopus cotulifer	June	13.8	6.0	1.2	29.9	5.2	43.9	0.41	0.15	65.0	2.5	0.5	12.1	2.1	17.8	0.17	0.06
		Aug.	12.9	7.3	1.6	31.7	5.3	41.3	0.45	0.18	70.0	2.5	0.5	10.9	1.8	14.2	0.16	0.06
		Oct.	13.5	6.8	1.5	29.9	6.7	41.5	0.50	0.16	50.0	3.9	0.9	17.3	3.8	24.0	0.29	0.09
	Calamagrostis arundinacea	June	13.6	7.9	1.5	30.0	6.0	41.1	0.41	0.11	65.0	3.2	0.6	12.1	2.5	16.6	0.16	0.05
		Aug.	12.9	5.3	1.2	35.0	4.4	41.2	0.26	0.17	60.0	2.4	0.6	16.1	2.0	18.9	0.12	0.08
		Oct.	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—
	Digitaria sanguinalis	June	14.0	14.3	2.3	21.2	11.0	37.2	0.35	0.35	80.0	3.3	0.5	4.9	2.6	8.7	0.08	0.08
		Aug.	13.3	8.5	2.0	27.1	9.1	39.9	0.29	0.36	60.0	3.9	0.9	12.5	4.2	18.4	0.14	0.16
		Oct.	13.4	8.6	1.2	26.0	9.5	41.2	0.26	0.29	60.0	4.0	0.5	12.0	4.4	19.1	0.12	0.13
	Setaria viridis	June	13.6	14.9	2.7	22.7	4.3	41.8	0.41	0.26	74.0	4.5	0.8	6.8	1.3	12.6	0.12	0.08
		Aug.	13.1	13.0	2.3	28.5	10.2	32.9	0.42	0.25	68.5	4.8	0.8	10.5	4.0	12.1	0.15	0.09
		Oct.	13.3	9.8	2.1	29.6	9.2	36.0	0.36	0.29	45.0	6.2	1.4	18.8	5.8	22.9	0.23	0.18
	Echinochloa echinata	June	12.8	22.9	4.6	20.4	11.5	27.8	0.63	0.41	85.0	4.0	0.8	3.5	2.9	4.8	0.11	0.07
		Aug.	13.3	18.3	3.2	24.5	12.1	28.5	0.27	0.37	80.0	4.2	0.7	5.7	2.8	0.6	0.06	0.09
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Phragmites prosturatus	June	13.2	12.2	2.3	24.1	7.9	40.4	0.43	0.15	46.0	7.6	1.5	15.0	4.9	25.1	0.27	0.09
		Aug.	13.6	11.5	1.6	29.8	8.6	34.9	0.22	0.12	60.0	5.3	0.7	13.8	4.0	16.2	0.10	0.06
		Oct.	13.4	12.5	1.2	23.8	9.5	39.7	0.22	0.16	55.0	6.5	0.6	12.4	4.9	20.6	0.11	0.09
	Calamagrostis epigeios	June	13.6	5.9	1.5	31.7	5.4	41.9	0.17	0.11	47.0	3.6	0.9	19.5	3.3	25.7	0.11	0.07
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Beckmannia eruceaformis	June	13.6	17.4	3.5	23.5	8.4	33.0	0.30	0.42	80.0	4.0	0.8	5.4	2.0	7.8	0.07	0.01
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Andropogon micranthus	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	12.6	5.9	1.5	30.2	6.7	43.1	0.31	0.17	60.0	2.7	0.7	13.8	3.1	19.7	0.14	0.08
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	Species	Month	Air dry basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P	Green basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
	Eragrostis ferruginea	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	13.1	9.2	2.2	29.2	7.1	39.2	0.27	0.29	60.0	4.2	1.0	13.4	3.3	18.1	0.12	0.13
		Oct.	12.9	6.3	0.6	28.1	6.0	46.2	0.23	0.26	40.0	4.4	0.4	19.34	4.1	31.8	0.16	0.18
	Pennisetum japonica	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	13.6	5.7	1.5	33.8	6.5	39.0	0.27	0.18	55.0	3.0	0.8	17.6	3.4	20.3	0.14	0.09
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lespedeza striata	June	12.0	14.3	2.6	18.6	5.6	46.9	1.02	0.18	65.0	5.7	1.0	7.4	2.2	18.7	0.41	0.07
		Aug.	12.6	12.9	2.4	28.7	5.8	37.7	0.84	0.17	65.0	5.2	1.0	11.5	2.3	15.1	0.34	0.07
		Oct.	12.4	12.8	1.4	30.0	4.7	38.8	0.93	0.15	40.0	8.8	0.9	2.6	3.2	26.5	0.64	0.10
	Lespedeza cuneata	June	13.1	11.5	2.1	21.9	3.8	46.6	0.94	0.12	65.0	4.7	0.8	9.2	1.5	18.8	0.38	0.05
		Aug.	13.6	8.4	2.4	26.9	4.6	44.1	0.29	0.13	65.0	3.4	1.0	10.9	1.9	17.9	0.12	0.05
		Oct.	13.4	11.5	2.2	21.1	5.8	46.1	1.50	0.15	35.0	8.6	1.6	15.9	4.4	34.1	1.12	0.11
	Viciaamoena fischer	June	13.6	22.5	2.4	23.0	6.9	31.6	1.11	0.31	65.0	9.1	1.0	9.3	2.8	12.8	0.45	0.13
		Aug.	13.7	13.3	1.9	27.6	4.6	38.9	0.98	0.18	65.0	5.4	0.8	11.2	1.9	15.8	0.40	0.07
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Pueraria thunbergiana	June	13.0	8.6	1.0	29.2	7.5	40.8	1.68	0.21	63.0	3.6	0.4	12.4	3.2	71.4	0.71	0.09
		Aug.	12.7	11.3	1.8	31.8	6.4	36.0	1.71	0.21	65.0	4.5	0.7	12.8	2.5	14.4	0.67	0.08
		Oct.	13.3	12.7	2.9	22.0	8.6	41.5	2.70	0.18	50.0	7.4	1.1	12.7	4.9	23.9	1.56	0.11
	Robinia pseudo acacia	June	12.6	23.6	2.6	14.3	4.8	42.1	1.50	0.23	60.0	10.8	1.2	6.6	2.2	19.3	0.69	0.10
		Aug.	12.6	22.1	2.6	17.9	6.4	38.4	1.38	0.24	65.0	8.9	1.1	7.6	2.5	15.4	0.55	0.10
		Oct.	13.1	19.0	2.4	17.9	5.9	41.6	1.55	0.18	60.0	8.8	1.1	8.2	2.7	19.2	0.71	0.08
	Lespedeza spp.	June	13.3	12.2	2.3	23.6	3.1	45.5	0.91	0.14	55.0	6.3	1.2	12.2	1.6	23.6	0.47	0.07
		Aug.	13.6	10.2	3.7	23.6	4.2	44.6	1.09	0.12	60.0	4.7	1.7	10.9	2.0	20.7	0.50	0.06
		Oct.	13.1	10.6	5.7	30.0	5.7	35.0	1.75	0.10	40.0	7.3	3.9	20.7	3.9	24.1	1.18	0.07
	Lespedeza cytissides	June	12.9	12.6	1.6	18.8	5.1	48.9	1.99	0.10	62.0	5.5	0.7	8.2	2.2	21.3	0.87	0.05
		Aug.	13.6	12.7	3.3	20.5	6.3	43.7	2.83	0.18	60.0	5.9	1.5	9.5	2.9	20.3	1.31	0.08
		Oct.	12.7	10.6	4.7	15.2	7.3	49.6	3.06	0.09	40.0	7.3	3.2	10.4	5.0	34.1	2.11	0.06
Jinju	*Zijania caduciflora*	June	13.2	14.4	2.9	28.9	8.8	31.9	0.16	0.15	65.0	5.8	1.2	11.6	3.5	12.9	0.07	0.06

Location	Species	Month	Air dry basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P	Green basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
		Aug.	12.9	12.5	1.8	28.5	9.7	34.7	0.24	0.18	68.0	4.6	0.7	10.5	3.5	12.7	0.09	0.07
		Oct.	13.4	5.4	1.6	29.3	9.6	40.7	0.19	0.04	68.0	2.0	0.6	10.8	3.5	15.0	0.07	0.02
	Cymbopogon goeringii	June	13.4	7.7	4.6	26.8	5.4	42.1	0.33	0.14	59.0	3.7	2.2	12.7	2.6	19.9	1.56	0.07
		Aug.	13.0	5.3	2.9	34.8	4.9	39.1	0.47	0.09	68.0	2.9	1.1	12.8	1.8	14.4	0.17	0.03
		Oct.	13.[illegible]	4.0	3.7	34.4	4.2	40.9	0.13	0.07	40.0	2.8	2.2	23.8	2.9	25.3	0.09	0.05
	Andropogon micranthus	June	13.[illegible]	7.2	2.0	26.7	5.8	45.0	0.31	0.13	65.0	2.9	0.8	10.8	2.3	18.2	0.13	0.05
		Aug.	12.7	6.0	1.5	33.7	7.2	39.0	0.29	0.10	60.0	2.8	0.7	15.4	3.3	17.9	0.12	0.05
		Oct.	13.1	3.1	0.8	31.6	7.5	44.0	0.38	0.05	50.0	1.8	0.5	18.2	4.3	25.3	0.22	0.03
	Digitaria sanguinalis	June	12.4	17.1	4.5	20.4	10.6	35.1	0.32	0.48	84.0	3.1	0.8	3.7	1.9	6.4	0.06	0.09
		Aug.	12.7	11.7	2.8	25.8	9.7	37.4	0.24	0.31	81.5	2.5	0.6	5.5	2.1	7.9	0.05	0.07
		Oct.	12.4	9.5	1.1	27.3	9.0	40.7	0.23	0.26	67.0	3.6	0.4	10.3	3.4	15.3	0.11	0.10
	Phragmites prosturatus	June	13.2	14.4	2.3	26.1	4.9	39.1	0.22	0.15	58.0	6.9	1.1	12.6	2.4	18.9	0.11	0.07
		Aug.	13.4	12.6	2.2	29.9	5.1	36.8	0.23	0.16	69.0	4.5	0.8	10.7	1.8	13.2	0.08	0.06
		Oct.	13.8	10.9	1.8	31.5	7.2	34.9	0.16	0.10	60.0	5.0	0.8	14.6	3.3	16.2	0.07	0.05
	Calamagrostis arundinacea	June	13.5	8.8	2.3	29.8	6.5	39.1	0.33	0.11	60.0	4.1	1.1	13.8	3.9	18.1	0.15	0.05
		Aug.	12.9	6.8	1.8	37.3	8.5	32.7	0.19	0.10	65.0	2.7	0.7	15.0	3.4	13.1	0.08	0.04
		Oct.	12.9	6.0	1.3	34.6	8.4	36.7	0.14	0.09	60.0	2.8	0.6	15.9	3.8	16.9	0.06	0.04
	Eragrostis ferruginea	June	12.0	10.0	2.6	24.7	6.6	44.1	0.31	0.33	63.0	4.2	1.1	10.4	2.8	18.5	0.13	0.14
		Aug.	12.6	7.8	1.7	33.4	5.7	38.8	0.20	0.20	60.5	3.5	0.8	15.1	2.6	17.5	0.09	0.09
		Oct.	12.1	7.0	1.2	30.1	5.8	43.8	0.20	0.13	60.0	3.2	0.5	13.7	2.6	20.0	0.09	0.06
	Arundinella hirta	June	12.6	6.8	1.5	31.3	4.8	43.0	0.23	0.11	67.0	2.6	0.6	11.8	1.8	16.3	0.09	0.04
		Aug.	12.5	5.0	0.9	35.0	4.0	42.6	0.25	0.08	60.0	2.3	0.4	16.0	1.8	19.5	0.11	0.04
		Oct.	12.9	3.8	1.9	33.0	4.0	44.5	0.19	0.09	60.0	1.7	0.9	15.2	1.9	20.4	0.09	0.04
	Imperata cylindrica	June	13.3	7.7	2.2	33.7	4.3	38.9	0.21	0.20	65.0	3.1	0.9	13.6	1.7	15.7	0.08	0.08
		Aug.	12.9	6.1	2.1	38.7	4.1	36.2	0.15	0.10	67.0	2.3	0.8	14.7	1.6	13.7	0.06	0.04
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Themeda japonica	June	12.6	7.4	1.6	33.5	4.9	40.0	0.25	0.15	61.0	3.3	0.7	15.0	2.2	17.9	0.11	0.07
		Aug.	12.3	5.8	1.3	33.1	5.9	41.6	0.25	0.10	68.0	2.1	0.5	12.1	2.2	15.2	0.09	0.04

Location	Species	Month	Air dry basis (%)								Green basis (%)							
			Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P	Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
		Oct.	12.4	3.3	1.4	35.6	5.3	42.1	0.15	0.04	51.0	1.8	0.8	19.9	3.0	23.6	0.08	0.02
	Eulia speciosa	June	12.1	6.9	1.8	31.7	5.3	42.2	0.26	0.12	62.5	3.0	0.8	13.5	2.3	18 0	0.11	0.05
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	13.0	2.0	1.1	37.3	4.0	42.5	0.10	0.05	49.0	1.2	0.7	21.9	2.4	24.9	0.06	0.03
	Eccoilopus cotulifer	June	13.4	8.1	1.7	28.1	4.6	44.1	0.42	0.14	69.0	2.9	0.6	10.1	1.7	15.8	0.15	0.02
		Aug.	12.7	5.2	1.0	33.5	4.5	43.0	0.59	0.09	62.0	2.3	0.5	14.6	2.0	18.7	0.26	0.04
		Oct.	12.5	3.5	0.5	34.3	4.1	44.6	0.35	0.06	50.0	2.0	0.3	19.6	2.7	25.5	0.20	0.04
	Pennisetum japonia	June	12.7	12.5	2.9	24.4	10.0	37.6	0.28	0.29	72.0	4.0	0.9	7.8	3.2	12.1	0.09	0.09
		Aug.	13.1	8.5	1.5	32.3	4.2	40.5	0.30	0.21	77.0	2.3	0.4	8.5	1.1	10.7	0.08	0.06
		Oct.	13.0	6.7	1.2	31.6	8.3	39.3	0.33	0.17	75.0	1.9	0.3	9.1	2.4	11.3	0.10	0.05
	Miscanthus purpurascens	June	13.0	7.7	1.8	32.4	4.4	40.8	0.28	0.13	60.0	3.5	0.8	14.9	2.0	18.7	0.13	0.06
		Aug.	12.7	6.3	1.3	36.8	4.4	38.5	0.17	0.11	60.0	2.9	0.6	16.9	2.0	17.6	0.08	0.05
		Oct.	12.9	4.3	0.6	33.1	5.3	43.7	0.19	0.09	60.0	2.0	0.3	15.2	2.5	20.1	0.09	0.04
	Calamagrostis arundinacea	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	13.7	4.5	1.6	36.3	4.7	39.3	0.14	0.07	62.0	2.0	0.7	16.0	2.1	17.3	0.06	0.03
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lespedeza striata	June	12.8	16.3	5.7	25.2	6.5	33.6	1.01	0.32	70.0	5.6	2.0	8.7	2.2	11.6	0.35	0.11
		Aug.	13.4	12.1	2.0	31.7	4.6	36.3	0.34	0.18	62.0	5.3	0.9	13.9	2.0	15.9	0.15	0.08
		Oct.	12.3	12.2	1.3	37.0	4.5	32.7	0.66	0.37	50.5	7.0	0.8	21.1	2.6	18.7	0.38	0.21
	Lespedeza daurica	June	12.3	13.1	2.4	23.6	4.7	44.0	0.86	0.15	62.5	5.6	1.0	10.1	2.0	18.8	0.37	0.06
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lespedeza cuneata	June	13.1	13.8	2.5	26.4	5.0	39.1	1.02	0.17	63.0	5.9	1.1	11.3	2.1	16.7	0.43	0.07
		Aug.	12.7	10.0	1.6	35.0	4.3	36.5	0.91	0.10	60.0	4.6	0.7	16.0	2.0	16.7	0.42	0.04
		Oct.	12.8	7.5	1.4	41.0	3.5	33.8	0.87	0.09	—	—	—	—	—	—	—	—
	Lespedeza cytissides	June	13.3	13.1	2.9	18.7	3.6	48.5	0.73	0.10	—	—	—	—	—	—	—	—
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	Species	Month	Air dry basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P	Green basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
	Pueraria thunbergiana	June	12.6	19.3	2.7	22.4	7.5	35.6	1.64	0.18	77.0	5.1	0.7	5.9	2.0	9.4	0.43	0.06
		Aug.	13.1	13.3	1.8	29.9	7.6	34.2	1.80	0.11	—	—	—	—	—	—	—	—
		Oct.	13.7	12.0	2.3	24.8	9.1	38.1	0.28	0.11	68.0	4.4	0.9	9.2	3.4	14.1	0.10	0.04
	Vicia japonica	June	13.2	17.4	2.0	25.1	4.4	37.9	0.85	0.19	72.0	5.6	0.6	8.1	1.4	12.2	0.27	0.06
		Aug.	13.5	12.0	1.9	34.0	4.2	34.9	0.80	0.16	60.0	5.6	0.6	15.7	1.9	16.1	0.39	0.07
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Aeschynomene indica	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	—	—	—	—	—	—	—	—	62.0	7.9	1.0	10.8	2.3	16.1	0.43	0.07
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jeju	*Imperata cylindrica*	June	13.6	7.1	1.1	33.6	3.9	40.7	0.17	0.12	60.5	3.2	0.5	15.4	1.8	18.6	0.08	0.06
		Aug.	13.1	4.5	1.5	33.7	3.8	43.5	0.24	0.11	60.0	2.1	0.7	15.5	1.7	20.0	0.11	0.05
		Oct.	13.4	4.2	1.6	35.4	4.6	40.9	0.18	0.09	54.0	2.2	0.9	14.8	2.4	21.7	0.10	0.05
	Andropogon micranthus	June	12.9	6.0	0.5	30.2	7.8	42.6	0.40	0.12	65.5	2.4	0.2	11.9	3.1	16.9	0.16	0.05
		Aug.	13.0	4.1	2.8	32.3	7.1	42.7	0.25	0.12	56.0	2.1	0.4	16.3	3.6	21.6	0.13	0.06
		Oct.	12.6	3.4	0.7	21.6	9.5	42.3	0.19	0.07	51.0	1.9	0.4	17.7	5.3	23.7	0.11	0.04
	Miscanthus sinensis	June	13.2	6.1	0.5	33.5	4.8	41.9	0.21	0.14	62.7	2.6	0.2	14.4	2.1	18.0	0.09	0.06
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Holcus fulvus	June	13.1	6.9	1.0	25.4	11.2	42.4	0.35	0.18	66.5	2.7	0.4	9.9	4.3	16.4	0.13	0.07
		Aug.	12.7	3.8	0.6	35.1	5.5	42.3	0.21	0.10	54.0	2.0	0.3	18.5	2.9	22.3	0.11	0.05
		Oct.	12.6	3.5	0.6	32.0	7.4	43.9	0.17	0.10	58.0	1.7	0.3	15.4	3.6	21.1	0.08	0.05
	Setaria chondrachne	June	13.6	9.2	0.4	28.6	8.8	39.4	0.22	0.22	68.0	3.4	0.2	10.6	3.2	14.6	0.08	0.08
		Aug.	12.9	5.8	0.7	32.1	8.0	40.5	0.22	0.22	59.0	2.7	0.3	15.1	3.8	19.1	0.20	0.10
		Oct.	13.0	4.9	0.7	30.7	6.7	44.0	0.26	0.23	62.0	2.2	0.3	13.4	2.9	19.2	0.07	0.10
	Themeda japonica	June	13.6	6.4	0.9	27.3	11.1	40.7	0.30	0.20	65.0	2.6	0.4	11.0	4.5	16.5	0.12	0.08
		Aug.	12.9	4.8	1.1	32.8	4.0	44.4	0.14	0.10	58.0	2.3	0.5	15.8	1.9	21.4	0.07	0.05
		Oct.	13.6	2.8	0.3	34.1	6.1	43.0	0.12	0.07	39.0	2.0	0.2	24.1	4.4	30.3	0.09	0.05
	Cymbopogon goeringii	June	12.9	5.8	2.8	26.0	5.8	46.7	0.30	0.11	63.2	2.4	1.2	11.0	2.5	19.7	0.13	0.11

Location	Species	Month	Air dry basis (%)								Green basis (%)							
			Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P	Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
		Aug.	12.4	2.7	2.8	36.1	3.7	42.3	0.11	0.10	52.0	1.5	1.5	19.8	2.0	23.2	0.06	0.05
		Oct.	13.1	2.6	2.3	34.4	3.8	43.8	0.10	0.06	43.0	1.7	1.5	22.6	2.5	28.8	0.07	0.04
	Miscanthus purpurascens	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	12.3	5.4	1.4	33.6	5.7	41.7	0.18	0.12	64.0	2.2	0.6	13.8	2.3	17.1	0.08	0.05
		Oct.	12.9	3.1	1.0	35.9	4.3	43.0	0.10	0.08	57.0	1.5	0.5	17.7	2.1	21.2	0.05	0.04
	Cassia nomame	June	12.5	15.6	2.7	20.8	4.9	44.3	0.81	0.15	72.5	4.9	0.9	6.5	1.3	13.9	0.26	0.05
		Aug.	13.4	4.4	2.1	30.1	2.9	47.1	0.74	0.11	64.0	1.8	0.9	12.5	1.2	19.6	0.31	0.05
		Oct.	12.7	8.1	0.5	38.1	2.9	37.7	0.63	0.13	55.0	4.2	0.3	19.7	1.5	19.4	0.32	0.07
	Glycine ussuriensis	June	13.4	13.7	1.1	28.5	7.0	36.4	1.34	0.15	73.0	4.3	0.4	8.9	2.2	11.3	0.42	0.55
		Aug.	13.6	12.2	1.6	31.5	5.2	35.9	1.32	0.13	66.0	4.8	0.6	12.4	2.1	14.1	0.52	0.55
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lespedeza spp.	June.	13.2	19.0	1.3	25.9	3.4	37.1	0.60	0.15	68.0	7.0	0.5	9.6	1.3	13.7	0.22	0.09
		Aug.	13.0	14.0	2.6	26.9	2.9	40.6	0.71	0.11	65.0	5.5	1.0	10.7	1.2	16.1	0.48	0.05
		Oct.	13.5	12.9	2.2	31.5	3.9	36.0	1.01	0.21	58.0	6.3	1.1	15.3	1.9	17.5	0.49	0.01
	Lespedeza cuneata	June	12.8	12.3	1.2	28.7	4.9	40.3	0.99	0.13	58.0	5.9	0.6	13.8	2.3	19.3	0.48	0.06
		Aug.	13.4	10.1	1.9	33.3	4.1	37.3	1.04	0.14	51.0	5.7	1.1	18.9	2.3	22.1	0.59	0.08
		Oct.	12.7	11.2	2.3	33.3	4.2	36.4	1.11	0.13	51.0	6.3	1.3	18.7	2.4	20.4	0.63	0.07
	Astragalus membranaceus	June	12.9	11.7	1.9	30.1	5.4	38.0	0.24	0.18	72.2	3.7	0.6	9.6	1.7	12.1	0.08	0.06
		Aug.	13.3	11.7	1.5	30.8	7.8	38.9	0.25	0.18	52.0	6.5	0.8	17.1	4.3	19.3	0.14	0.10
		Oct.	13.2	11.4	1.5	30.8	6.4	36.8	0.42	0.17	60.0	5.3	0.8	14.2	2.9	17.0	0.19	0.08
	Lespedeza pilosa	June	13.2	9.1	1.4	32.8	7.0	36.5	0.87	0.11	41.2	6.2	0.9	22.2	4.8	24.7	0.59	0.08
		Aug.	13.1	9.2	1.9	34.2	3.6	37.0	0.70	—	52.0	5.1	1.1	18.9	2.0	21.0	0.38	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Dunbaria villosa	June	12.8	15.5	2.9	27.4	4.6	36.8	0.74	0.17	65.5	6.1	1.2	10.8	1.8	14.6	0.29	0.07
		Aug.	13.3	12.4	3.4	28.2	4.2	38.5	0.07	0.16	66.2	4.8	1.3	11.0	1.6	15.0	0.26	0.06
		Oct.	—	—	—	—	—	—	—	—	56.0	5.0	1.3	16.8	1.9	19.1	0.37	0.05
	Artemisia japonica	June	12.4	13.0	2.0	21.3	8.0	43.3	1.12	0.29	70.5	4.4	0.7	7.2	2.7	14.6	0.38	0.10
		Aug.	13.0	6.3	2.7	31.0	4.7	42.4	0.70	0.16	60.5	2.8	1.2	14.1	2.1	19.2	0.32	0.17

Location	Species	Month	Air dry basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P	Green basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
		Oct.	12.7	0.2	2.5	29.7	5.0	44.0	0.95	0.15	47.0	3.8	1.5	18.0	3.0	26.7	0.58	0.09
Kueje	*Calamagrostis arundinacea*	June	13.1	8.0	0.9	30.3	9.1	38.0	0.29	0.12	66.5	3.3	0.3	11.7	3.5	14.6	0.11	0.05
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	13.4	4.5	1.9	39.1	6.0	35.2	0.12	0.12	39.3	3.1	1.3	27.4	4.2	24.7	0.08	0.08
	Miscanthus purpurascens	June	12.8	6.2	1.2	29.5	5.2	45.1	0.17	0.10	63.0	2.6	0.5	12.5	2.2	19.1	0.07	0.04
		Aug.	13.4	6.4	1.3	32.9	5.4	40.6	0.16	0.14	80.0	1.5	0.3	7.6	1.2	9.4	0.04	0.03
		Oct.	12.3	5.2	0.6	32.9	4.9	44.2	0.17	0.15	56.0	2.6	0.3	16.5	2.4	22.2	0.08	0.07
	Themeda japonica	June	13.5	0.1	0.9	29.3	6.1	50.2	0.22	0.10	67.5	0.1	0.3	11.0	2.3	18.9	0.08	0.04
		Aug.	12.8	5.8	1.3	34.5	5.5	40.1	0.20	0.14	78.0	1.5	0.3	8.7	1.4	10.1	0.05	0.04
		Oct.	12.7	2.1	1.6	36.5	4.4	42.7	0.07	0.07	34.0	1.6	1.2	27.6	3.3	32.3	0.05	0.05
	Imperata cylindrica	June	13.2	6.7	1.4	30.2	4.6	43.9	0.17	0.10	62.5	2.9	0.6	13.0	2.0	19.0	0.08	0.04
		Aug.	13.4	7.6	1.8	32.8	5.3	3.91	0.20	0.12	73.0	2.4	0.6	10.2	1.7	12.2	0.06	0.04
		Oct.	12.8	4.2	1.5	35.3	3.2	43.0	0.28	0.13	57.1	2.1	0.8	17.4	1.6	21.2	0.14	0.06
	Beckmannia erucaeformis	June	12.8	10.7	1.6	29.7	8.9	36.4	0.39	0.21	70.0	3.7	0.5	10.2	3.1	12.5	0.14	0.07
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Arundinella hirta	June	13.2	5.8	0.9	28.6	4.9	46.7	0.27	0.10	68.0	2.1	0.3	10.5	1.8	17.2	0.10	0.04
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	13.4	3.5	0.9	33.2	4.1	44.9	0.11	0.11	53.3	1.9	0.5	17.9	2.2	24.2	0.06	0.06
	Setaria viridis	June	12.6	7.7	1.9	22.9	4.6	50.4	0.28	0.24	72.0	2.5	0.6	7.3	1.5	16.1	0.09	0.08
		Aug.	12.2	7.0	1.7	30.5	7.4	41.1	0.22	0.37	80.0	1.6	0.4	7.0	1.7	9.4	0.05	0.08
		Oct.	13.4	4.2	1.2	31.5	10.2	39.5	0.28	0.29	66.2	1.7	0.5	12.3	4.0	15.4	0.11	0.11
	Eragrostis ferruginea	June	13.4	13.4	1.4	23.2	5.2	43.3	0.29	0.29	67.0	5.1	0.5	8.8	2.0	16.5	0.11	0.11
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Digitaria sanguinalis	June	13.2	12.3	0.6	25.4	11.7	36.9	0.43	—	77.0	3.3	0.2	6.7	3.1	9.8	0.12	—
		Aug.	12.5	8.5	2.2	29.2	9.3	38.4	0.25	0.32	83.0	1.6	0.4	5.7	1.8	7.5	0.05	0.06
		Oct.	13.2	6.3	1.5	29.4	8.7	04.9	0.26	0.18	73.3	1.9	0.5	9.0	2.7	12.6	0.08	0.06

Location	Species	Month	Air dry basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P	Green basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
	Cymbopogon goeringii	June	12.7	7.9	1.2	27.0	6.7	44.6	0.30	0.16	69.0	2.8	0.4	9.6	2.4	15.8	0.11	0.06
		Aug.	12.4	6.3	3.7	31.7	5.1	40.5	0.25	0.16	85.0	1.1	0.6	5.4	0.9	6.9	0.04	0.03
		Oct.	13.0	4.7	3.6	31.0	3.8	44.0	0.12	0.12	50.0	2.7	2.1	17.8	2.2	25.3	0.07	0.07
	Zoysia japonica	June	13.0	7.2	1.5	26.9	5.8	45.5	0.19	—	60.0	3.3	0.7	12.4	2.7	20.9	0.09	0.07
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Eccoilopus cotulifer	June.	13.2	6.9	1.2	27.9	6.1	44.7	0.32	0.10	66.0	2.7	0.5	10.9	2.4	17.5	0.13	0.04
		Aug.	12.9	8.8	2.1	32.5	5.2	37.5	0.29	0.19	79.0	2.1	0.5	7.8	1.5	9.1	0.07	0.05
		Oct.	12.6	3.6	0.6	35.8	3.5	42.9	0.19	0.05	42.0	2.4	0.4	21.4	2.3	28.5	0.13	0.04
	Eulia speciosa	June	12.7	7.3	1.8	30.7	4.8	42.7	0.27	0.10	65.5	2.8	0.7	11.8	1.8	16.4	0.10	0.04
		Aug.	12.4	5.0	2.1	31.4	4.6	41.5	0.19	0.08	77.0	1.3	0.6	9.0	1.2	10.9	0.05	0.02
		Oct.	12.8	2.6	0.7	36.0	4.1	43.9	0.10	0.07	41.0	1.7	0.4	23.1	2.6	28.2	0.06	0.04
	Eleusine indica	June	—	—	—	—	—				—	—	—	—	—	—	—	—
		Aug.	13.0	7.5	1.8	28.3	8.5	40.9	0.50	0.33	78.0	1.9	0.5	7.2	2.2	10.4	0.15	0.08
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Eragrostis ferruginea	June	12.3	13.5	1.4	23.4	5.3	43.7	0.30	0.30	67.0	5.1	0.5	8.9	2.0	16.5	0.11	0.11
		Aug.	13.1	8.6	2.3	31.9	5.1	39.0	0.19	0.21	71.0	2.9	0.8	10.6	1.7	13.0	0.05	0.08
		Oct.	12.1	4.3	0.6	28.8	8.0	45.2	0.21	0.20	60.0	2.0	0.3	13.3	3.7	20.8	0.10	0.09
	Phragmites prosturatus	June	—	—	—	—					—	—	—	—	—	—	—	—
		Aug.	12.2	13.1	2.1	33.3	6.4	32.9	0.18	0.16	80.0	3.0	0.5	7.6	1.5	7.5	0.04	0.04
		Oct.	12.3	10.2	2.2	28.9	7.1	39.3	0.22	0.12	50.0	5.8	1.3	16.5	4.1	22.4	0.13	0.07
	Andropogon micrantkus	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	13.1	3.3	0.9	30.4	7.5	44.9	0.17	0.07	44.8	2.1	0.6	19.3	4.8	28.5	0.10	0.06
	Lespedeza cuneata	June	13.3	15.6	0.7	20.8	4.0	45.7	1.00	0.16	57.6	7.6	0.4	10.2	2.0	22.4	0.49	0.08
		Aug.	12.7	10.4	1.6	32.1	3.7	39.6	0.64	0.19	75.0	3.0	0.5	9.2	1.0	11.3	0.18	0.05
		Oct.	13.2	9.3	1.8	17.1	5.4	33.2	0.76	0.12	57.1	4.6	0.9	18.4	2.7	63.4	0.38	0.06
	Pennisetum japonica	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	Species	Month	Air dry basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P	Green basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	12.2	4.8	1.6	33.1	8.1	40.3	0.21	0.25	63.0	1.7	0.6	12.1	2.9	14.7	0.08	0.09
	Pueraria thunbergiana	June	12.6	21.6	1.2	20.4	6.9	37.3	1.73	0.17	72.5	6.8	0.4	6.4	2.2	11.8	0.29	0.06
		Aug.	12.5	19.9	2.9	24.7	6.6	33.5	0.45	0.21	81.0	3.6	0.5	4.5	1.2	6.1	0.08	0.04
		Oct.	12.7	13.4	2.2	23.1	7.6	41.0	2.29	0.14	69.0	6.1	1.0	10.6	3.5	18.8	1.05	0.06
	Indigofera koreana	June	13.2	13.5	1.9	18.0	2.9	50.5	0.63	0.07	66.5	5.2	0.8	6.9	1.1	19.5	0.24	0.03
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cassia nomame	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	13.0	13.4	3.6	22.5	4.3	43.3	0.12	0.15	77.0	3.6	1.0	5.9	1.1	11.4	0.03	0.04
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lespedeza striata	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	12.5	13.2	2.0	29.6	4.4	38.3	1.12	0.23	74.0	3.9	0.6	8.8	1.3	11.4	0.33	0.07
		Oct.	12.6	13.7	1.1	35.8	11.0	25.8	0.48	0.21	33.3	10.4	0.8	27.3	8.4	19.7	0.37	0.16
	Falcata japonica	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	13.6	13.1	2.4	28.6	6.3	32.2	0.22	0.20	78.0	3.3	0.6	7.3	1.6	9.2	0.31	0.05
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Robinia pseudo acacia	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	13.2	20.2	2.5	13.9	4.9	45.4	0.82	0.16	85.0	3.5	0.4	2.4	0.8	7.8	0.14	0.03
		Oct.	13.0	14.4	3.2	17.5	4.2	47.7	1.37	0.11	68.4	5.3	1.2	6.3	1.5	17.3	0.50	0.03
Hwasan	*Eragrostis ferruginea*	June	12.7	7.9	3.0	25.8	4.6	45.9	0.21	0.14	57.8	3.8	1.5	12.5	2.2	22.2	0.10	0.07
		Aug.	13.2	7.9	1.7	32.0	4.6	40.6	0.13	0.20	71.1	2.6	0.6	10.7	1.6	13.5	0.05	0.07
		Oct.	13.1	6.3	1.1	28.5	5.1	46.0	0.15	0.12	44.4	4.0	0.7	18.2	3.3	29.4	0.09	0.08
	Miscanthus purpurascens	June	12.4	3.9	1.0	28.4	4.1	50.2	0.21	0.11	63.3	1.7	0.4	11.9	1.7	21.1	0.09	0.04
		Aug.	13.1	5.6	1.4	34.1	5.2	40.6	0.11	0.10	66.5	2.2	0.5	13.1	2.0	15.6	0.04	0.04
		Oct.	12.7	3.7	0.1	36.3	5.3	41.9	0.17	0.06	55.5	1.9	0.6	18.5	2.7	21.4	0.09	0.04
	Calamagrostis arundinacea	June	13.1	8.3	2.6	30.7	5.3	40.0	0.28	0.08	64.0	3.4	1.1	12.7	2.2	16.6	0.12	0.03
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	Species	Month	Air dry basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P	Green basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Zoysia japonica	June	13.1	5.8	1.2	27.1	4.5	48.3	0.21	0.10	49.7	3.4	0.7	15.7	2.6	28.0	0.12	0.06
		Aug.	13.4	9.8	1.2	29.8	5.3	40.5	0.22	0.32	33.2	7.6	0.9	23.0	4.1	31.3	0.17	0.25
		Oct.	13.0	6.2	1.6	27.3	7.0	45.6	0.23	0.18	41.0	4.2	0.7	18.5	4.8	30.9	0.15	0.12
	Themeda japonica	June	13.1	4.9	1.1	29.2	5.6	46.1	1.54	0.12	58.3	2.4	0.5	14.0	2.7	22.1	0.74	0.05
		Aug.	12.8	5.7	1.3	37.6	3.5	39.0	0.12	0.12	60.4	2.6	0.6	17.1	1.6	17.7	0.06	0.06
		Oct.	12.6	8.0	1.0	30.0	4.2	38.2	0.15	0.06	43.6	5.2	0.6	23.3	2.7	24.7	0.10	0.04
	Festuca ovina	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	12.7	8.2	2.9	31.7	4.7	39.8	1.62	0.10	54.6	4.3	1.5	16.5	2.5	20.7	0.84	0.05
		Oct.	12.9	8.5	2.9	30.1	5.2	40.5	0.17	0.10	54.8	4.4	1.5	15.6	2.7	21.0	0.09	0.05
	Calamagrostis arundinacea	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	13.0	10.5	2.7	31.0	7.6	35.3	0.31	0.24	68.4	3.8	1.0	11.3	2.8	12.8	0.11	0.09
		Oct.	12.8	7.7	1.5	32.3	9.7	36.0	0.19	0.11	55.3	4.0	0.8	16.5	5.0	18.4	0.10	0.06
	Cymbopogon goeringii	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	13.4	6.7	3.3	34.7	4.7	37.3	0.15	0.09	63.7	2.8	1.4	14.5	2.0	15.6	0.06	0.04
		Oct.	12.7	4.8	2.7	33.6	4.9	41.4	0.14	0.09	37.1	3.4	2.0	24.2	3.5	29.8	0.10	0.06
Kwangsan	*Arundinella hirta*	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	12.6	5.1	1.2	37.0	3.7	40.4	0.12	0.10	66.9	1.9	0.5	14.0	1.4	15.3	0.05	0.04
		Oct.	13.0	3.9	0.8	32.6	5.3	44.5	0.21	0.06	51.7	2.1	0.4	18.1	2.9	24.7	0.12	0.12
	Amorpha fructicosa	June	13.5	17.4	2.4	20.4	8.7	42.1	0.94	0.16	73.8	5.2	0.7	6.2	1.3	12.8	0.29	0.05
		Aug.	13.4	17.3	3.8	20.2	4.0	41.3	1.02	0.17	65.6	6.9	1.5	8.0	1.6	16.4	0.41	0.07
		Oct.	13.6	6.2	1.5	34.2	4.0	40.5	0.16	0.03	60.0	2.9	0.7	15.8	1.9	18.8	0.07	0.02
	Lespedeza striata	June	12.5	10.3	3.1	20.4	6.6	47.2	0.91	0.14	69.7	3.6	1.1	7.1	2.3	16.3	0.32	0.05
		Aug.	12.4	15.7	2.5	24.8	4.6	40.2	0.13	0.12	66.9	5.9	0.9	9.4	1.7	15.2	0.05	0.05
		Oct.	12.8	14.6	5.9	31.4	5.4	29.9	0.53	0.24	9.7	15.1	0.8	32.5	5.6	30.9	0.55	0.24
	Lespedeza bicolor	June	13.0	14.7	1.8	26.1	3.8	40.6	0.56	0.12	65.5	5.8	0.7	10.4	1.5	16.1	0.22	0.05
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	Species	Month	Air dry basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NEF	Ca	P	Green basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
	Lespedeza cuneata	June	12.0	10.3	1.0	25.0	9.3	41.4	0.71	0.12	59.3	4.8	0.5	11.7	4.4	19.4	0.33	0.06
		Aug.	13.0	14.1	1.8	29.6	4.4	37.0	0.78	0.23	62.2	6.1	0.8	12.9	1.9	16.1	0.34	0.10
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Astragalus membranaceus	June	12.6	13.6	1.8	17.3	8.2	50.5	0.29	0.09	66.8	5.2	0.7	6.6	1.6	19.2	0.15	0.03
		Aug.	12.9	12.8	2.1	20.0	5.7	46.5	0.71	0.20	61.3	5.7	0.9	8.9	2.5	20.7	0.33	0.09
		Oct.	12.4	6.9	2.1	26.7	4.7	47.3	1.45	0.04	20.6	6.3	1.9	24.2	4.3	42.9	1.31	0.04
	Lespedeza spp.	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	13.1	13.8	3.2	27.9	4.9	37.1	0.79	0.16	62.2	6.0	1.4	12.2	2.2	16.2	0.34	0.07
		Oct.	12.6	8.5	1.5	41.9	3.6	31.8	0.97	0.10	48.3	5.1	0.9	24.8	2.2	18.8	0.57	0.06
	Carex birvensis	June	13.1	7.8	4.2	27.1	4.2	43.6	0.19	0.11	57.6	3.8	2.1	13.2	2.0	21.3	0.09	0.06
		Aug.	12.8	10.0	2.4	26.4	4.1	44.3	0.21	0.10	51.6	5.2	1.2	13.8	2.1	23.1	0.11	0.05
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Artemisia japonica	June	12.9	7.3	2.8	18.0	7.5	51.6	0.98	0.12	69.7	2.5	1.0	6.3	2.6	17.9	0.31	0.04
		Aug.	13.2	3.4	2.8	23.3	6.4	51.0	0.97	0.12	66.9	1.3	1.1	8.9	2.4	19.4	0.37	0.05
		Oct.	12.6	7.0	2.1	20.8	8.7	48.9	1.18	0.10	69.1	2.5	0.7	7.3	3.1	17.3	—	0.04
	Carex lanceolata	June	12.6	5.0	1.3	25.1	4.9	5.1	0.28	0.06	54.3	2.6	0.7	13.2	2.6	26.7	0.15	0.03
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Artemisia asiatica	June	12.9	14.7	5.2	16.1	8.2	43.0	0.64	0.23	69.8	5.1	1.8	5.6	2.8	14.9	0.22	0.08
		Aug.	12.9	14.2	3.8	24.3	7.6	37.6	0.69	0.29	76.2	3.9	1.1	6.6	2.1	10.1	0.19	0.08
		Oct.	13.2	13.8	3.5	19.0	7.5	43.0	0.79	0.25	72.9	4.3	1.1	5.9	2.3	13.4	0.25	0.08
	Arundinella hirta	June	13.6	6.5	1.2	30.0	4.2	44.7	0.16	0.09	65.0	2.6	0.5	12.1	1.7	18.1	0.06	0.04
		Aug.	13.4	3.7	1.5	32.5	4.0	44.9	0.14	0.07	69.0	1.3	0.5	11.7	1.4	16.1	0.05	0.02
		Oct.	13.9	3.4	0.8	33.8	3.6	44.6	0.15	0.05	54.0	1.8	0.4	18.1	2.0	23.8	0.07	0.03
	Phragmites prosturatus	June	12.7	13.4	2.2	29.5	8.1	34.1	0.17	0.16	60.0	6.1	1.0	13.5	3.7	15.6	0.08	0.07
		Aug.	13.6	11.7	1.2	31.3	7.7	34.5	0.13	0.12	65.0	4.7	0.5	12.7	3.1	14.0	0.05	0.05
		Oct.	12.7	10.6	1.4	28.5	6.9	39.9	0.13	0.12	62.0	4.6	0.6	12.4	3.0	17.4	0.06	0.05
	Themeda japonica	June	12.9	6.8	1.6	29.5	5.3	43.9	0.14	0.10	64.0	2.8	0.7	12.2	2.2	18.2	0.06	0.04

Location	Species	Month	Air dry basis (%)								Green basis (%)							
			Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P	Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
		Aug	12.4	5.2	1.1	35.6	3.9	41.8	0.19	0.09	70.0	1.8	0.4	12.2	1.3	14.3	0.07	0.03
		Oct	12.3	5.4	1.6	33.2	4.5	43.0	0.14	0.12	38.0	3.8	1.2	23.5	3.2	30.4	0.10	0.09
	Miscanthus purpurascens	June	13.2	7.0	2.5	29.3	4.7	43.3	0.11	0.10	65.0	2.8	1.0	11.8	1.9	17.5	0.05	0.04
		Aug.	12.6	4.5	0.5	33.6	4.4	44.4	0.11	0.06	55.0	2.3	0.3	17.3	2.3	22.9	0.06	0.03
		Oct.	12.9	3.4	1.0	32.8	3.8	46.0	0.14	0.08	51.0	1.9	0.6	18.5	2.2	25.9	0.08	0.04
	Eragrostis ferruginea	June	11.9	9.2	3.2	27.3	5.5	42.8	0.24	0.27	63.0	3.9	1.4	11.5	2.3	18.0	0.10	0.11
		Aug.	12.4	8.1	1.9	34.2	5.3	38.0	0.20	0.25	74.0	2.4	0.6	10.2	1.6	11.3	0.06	0.07
		Oct.	12.3	8.3	1.8	29.0	4.8	43.8	0.20	0.23	57.0	4.1	0.9	14.2	2.3	21.5	0.10	0.11
	Imperata cylindrica	June	12.2	8.2	2.2	29.1	4.5	44.0	0.19	0.13	70.0	2.7	0.8	9.5	1.5	15.0	0.07	0.05
		Aug.	12.7	6.6	1.4	35.1	4.2	40.0	0.23	0.16	70.0	2.3	0.5	12.1	1.5	13.8	0.08	0.05
		Oct.	12.6	4.0	1.1	36.2	2.3	43.2	0.13	0.06	53.0	2.1	0.6	19.5	1.6	23.2	0.07	0.03
	Eulia speciosa	June	13.1	6.1	2.1	30.0	5.3	43.4	0.14	0.09	62.0	2.7	0.9	13.1	2.3	19.0	0.06	0.04
		Aug.	12.6	4.5	1.7	35.7	3.9	41.6	0.25	0.10	65.0	1.8	0.7	14.3	1.6	16.7	0.10	0.04
		Oct.	12.3	1.7	0.9	39.9	2.9	42.4	0.18	0.04	57.0	0.8	0.4	19.6	1.4	20.8	0.09	0.02
	Zijania caduciflora	June	13.0	11.5	2.9	25.6	10.3	36.7	0.13	0.16	69.0	4.1	1.0	9.1	3.7	13.1	0.06	0.06
		Aug.	13.2	9.0	1.5	30.9	8.3	37.1	0.17	0.09	75.0	2.6	0.4	8.9	2.4	10.7	0.05	0.03
		Oct.	12.7	7.9	2.1	27.6	11.1	38.5	0.15	0.08	75.0	2.3	0.6	7.9	3.2	11.0	0.04	0.02
	Paspalum thunbergii	June	13.6	9.2	2.2	24.4	6.3	43.3	0.27	0.15	78.6	2.3	0.8	6.1	1.6	10.7	0.07	0.04
		Aug.	13.7	6.6	0.9	33.7	6.1	39.0	0.23	0.11	79.0	1.6	0.2	8.2	1.5	9.5	0.06	0.03
		Oct.	13.0	5.2	1.0	30.6	6.1	44.2	0.14	0.15	67.0	2.0	0.4	11.6	2.3	16.8	0.05	0.06
	Cymbopogon goeringii	June	12.8	6.5	2.9	24.9	5.5	47.5	0.17	0.11	67.0	2.5	1.1	9.4	2.1	18.0	0.06	0.04
		Aug.	12.6	6.8	2.8	34.8	4.5	38.5	0.32	0.09	67.0	2.6	1.1	13.1	1.7	14.5	0.12	0.03
		Oct.	13.0	3.4	0.7	34.5	3.4	45.0	0.14	0.04	56.0	1.7	0.3	17.5	1.7	22.8	0.07	0.02
	Digitaria sanguinalis	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	12.9	8.1	1.2	29.2	6.7	42.0	0.22	0.13	60.0	1.9	0.3	6.7	1.5	9.6	0.05	0.03
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Andropogon micranthus	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	12.4	5.5	1.3	30.6	5.1	45.1	0.29	0.10	71.3	1.8	0.4	10.0	1.7	14.8	0.09	0.03

Location	Species	Month	Air dry basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P	Green basis (%) Moisture	C. Prot.	C. Fat	C. Fib.	C. Ash	NFE	Ca	P
		Oct.	12.3	2.5	0.6	31.2	6.0	47.4	0.27	0.05	38.0	1.8	0.4	22.1	4.3	33.5	0.19	0.04
	Lespedeza cuneata	June	12.1	12.9	2.2	27.3	5.3	40.3	0.81	0.16	65.0	5.1	0.9	10.9	2.1	16.0	0.32	0.06
		Aug.	12.7	11.7	2.0	28.8	3.9	40.7	0.84	0.16	66.0	6.0	1.0	14.5	2.0	20.5	0.42	0.08
		Oct.	12.6	9.1	1.2	38.8	3.6	34.8	0.07	0.11	42.0	6.0	0.8	25.7	2.4	23.1	0.05	0.08
	Lespedeza cytissides	June	12.9	14.1	3.1	17.3	3.0	49.7	0.43	0.10	60.0	6.5	1.4	7.9	1.4	22.8	0.20	0.04
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lespedeza striata	June	13.7	16.2	4.8	22.6	6.1	36.7	0.96	0.28	72.0	5.3	1.6	7.3	2.0	11.9	0.31	0.09
		Aug.	12.9	13.4	1.7	27.5	5.9	38.5	1.18	0.19	—	—	—	—	—	—	—	—
		Oct.	13.2	11.7	1.4	33.8	4.0	35.9	0.64	0.19	50.0	6.8	0.8	19.5	2.3	20.7	0.37	0.11
	Cassia nomame	June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	13.0	12.5	3.8	26.4	4.5	39.7	0.65	0.16	78.3	3.1	1.0	6.6	1.1	9.9	0.16	0.04
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—