韓國作物學會誌 第21卷 第1號 (1976)
J. Korean Soc. Crop. Sci. Vol. 21, No. 1:87—91

Study of Soybean Culture and Analysis on the Chemical Composition of Soybean for Making Use of the Mountainous Uncultivated Land.

Chang Duck Lee, Yoong Nam Song, Chun Bae Kim
Gangweon National University

山地遊休地活用을 爲한 大豆栽培 및 成分硏究

李 昌 德·宋 隆 男·金 春 培
江原大學

ABSTRACT

This study was undertaken to learn the over-all influence of fertilizer on soybean culture and the chemical composition of soybean in the reclaimed land. Treatments included five rates of N.P.K: 4. 10. 8, compost: 1,000, N.P.K.: 4. 10. 8+compost: 1,000, N.P.K: 2. 5. 5 kg/10 are as well as unfertilized plot in the reclaimed land and N.P.K: 4. 10. 8 kg/10 are as a check plot of the cultivated area. The yield of green plant above-ground, grain yield and protein content were higher in the cultivated plot than in the reclaimed land. Maximum yield of green plant or the greatest grain yield occurred in the plot of N.P.K: 4. 10. 8+compost: 1,000 kg application and they diminished as the fertilizer application decreased. Yet there was no statistical significance in the chemical seed composition among treatments.

INTRODUCTION

A series of project as related to the increase of food production in which research workers are trying to make use of the mountainous uncultivated land is being made. But sufficient detailed information is not available on the cropping system of the reclimed area which shows a proper combination of crops planted and an adequate cultural technique.

From 1972 Office of Rural Development has worked on the relevant experiments of investigation on the chemical or mechanical characteristics of soil in the reclaimed land and on the effect of fertilizer application.[3,4] Even though the fertilizer application to the soybean culture in reclaimed land has been recommended by Office of Rural Development, no apparent information has been accepted by farmers. Thus, many of them still grow soybean without applying fertilizer in reclaimed areas.

The objectives of this study was to find the most efficient way of fertilizer application in soybean culture of reclaimed area by measuring yield response, amount of green plant above-ground, TDN and chemical composition of grain.

MATERIALS AND METHODS

1. Soils and experimental design.

The field experiment was conducted in the reclaimed area three miles away from the cultivated field of this college. A composite soil sample was taken from each site and analyzed by the soil testing lab. at Gangweondo Office of Rural Development. Results of these soil analyses are given in table 1.

The variety "Bonguei" was sown in late June in 60cm width of rows spaced 20cm with three plants per hill. Only in the plot of N.P.K: 4, 10. 8kg, narrow space(60×10cm) was established next to the normal space plot(60×20cm). To remedy PH of the experimental field, 34kg $Ca(OH)_2$/10a was applied. For reclaimed land treatments of five fertilizer levels including unfertilized polt are as follow: N.P.K: 4. 10. 8, N.P.K: 2. 5. 5, compost: 1,000, N.P.K: 4. 10. 8+compost: 1,000kg/10a and non-fertilizer plot. A randomized complete block design was used with four replications. Only single plot of N.P.K: 4. 10. 8kg/10a was established for the cultivated site. Conventional analysis of variance technique was used in analyzing and interpreting the data.

Tible 1. Soil analysis used for experiment.

	PH	Total Nitrogen (%)	P_2O_5 (ppm)	Exchangeable (me/100g) K	Ca	Mg	O.M. (%)
Cultivated plot	5.9	0.11	413.3	0.49	3.3	1.9	2.17
Reclaimed plot	6.3	0.11	69.7	0.17	3.5	2.4	2.90

2. Yield of green plant and TDN

Samples were taken from 4 square meter of each plot and observed on the weight of green plant and that of dried materials. For TDN analysis, after 2g sample was analyzed for moisture, fat and fibre, NFE was multiplied to soluble protein, soluble fibre and soluble fat by 2.25 to estimate the value of TDN.

3. Analysis on chemical composition of grain.

Total N in grain was determined by distillation and titration after microkjeldahl digestion of 500-mg sample with sulfuric and salicyclic acid. Protein of grain was calculated by multiplying the value obtained by 6.25. Carbohydrate content was measured by the method of Somogi. Also, fat content was determined by Soxhlet method.

RESULTS AND DISCUSSIONS

1. Weight of above-ground green plant and TDN.

In order to know the utility of soybean as a forage crop. green plants were cut on Aug. 22 when flowering brought to a termination and most of pods were formed, then investigations on the yield of green plant and hay yield as well as TDN were made. The results of estimation on them are presented in table 2. The cultivated experimental plot

Tible 2. Yieldof green and dried plant and TDN

Treatment	Yield of green plant(kg/10a)	Yield of hay (kg/10a)	TDN (%)
Cultivated plot	1,956.3	397.6	34.84
Reclaimed plot N.P.K:4. 10. 8kg	1,320.0	283.0	33.55
N.P.K:4. 10. 8kg (60×10cm)	1,249.7	276.0	30.44
Compost: 1,000kg	1,075.9	251.9	30.11
Compost: 1 000kg+N.P.K: 4. 10. 8kg	1,589.1	343.3	31.37
N.P.K:2. 5. 5kg	1,111.8	240.9	32.37
Non-fertilizer	671.2	159.3	32.44
F value	13.2**	18.9**	0.8
L.S.D. 5% level	253.0	41.9	—
1% level	350.5	57.5	—

produced higher yield and showed higher TDN than the reclaimed plot did. Treatments of different level fertilizer were found to be highly significant at the 1 percent level in view of yield of green plant or hay yield. The highest yield were obtained with the plot of N.P.K: 4.10.8+compost: 1,000kg/10a and the yield response was due largely to increased fertilizer application. The green yield of large population plot (60×10cm) was lower than normal population plot(60×20cm). In general, TDN ratio had a tendency of decreasing as the yield increased and it was low in the large population plot.

2. Growth and grain yield.

No significant differences were detected among treatments for flowering time while some differences were found for maturity. In cultivated plot the maturity was found to be later than in reclaimed plot. About seven day difference of maturity occurred in reclimed plot.

In general, maturity delayed with the increment of fertilizer application and grain yield.

Tible 3. Evaluation on growth and grain yield

Treatment	Flowering time(Month & date)	Date of maturity (Month & date)	Stem length (cm)	Stem wt. (kg/10a)	Pod No.	100 grain wt.(g)	Grain yield (kg/10a)
Cultivated polt	8.12	10.12	58.7	154.4	45.3	26.6	434.7
Reclaimed plot N.P.K:4.10.8kg	8.12	10.7	43.5	62.2	25.4	24.1	171.4
N.P.K:4.10.8kg(60×10cm)	8.12	10.9	51.9	97.0	16.4	24.9	178.2
Compost: 1,000kg	8.12	10.5	43.0	71.1	22.1	22.5	152.2
Compost: 1,000kg+N.P.K:4.10.8kg	8.12	10.9	51.0	77.2	28.0	25.3	194.6
N.P.K: 2.5.5kg	8.12	10.5	41.0	52.3	21.5	24.7	161.8
Non-fertilizer	8.12	10.2	34.5	28.8	12.5	19.3	69.6
F value	—	—	16.5**	18.3**	19.2**	6.0**	24.7**
L.S.D. 5% level	—	—	4.9	18.7	3.9	2.8	27.3
1% level	—	—	6.7	26.0	5.4	3.9	37.8

Table 4. Chemical composition of grain.

Treatment	Protein(%)	Carbohydrate(%)	Fat(%)
Cultivated plot	41.10	19.29	18.52
Reclaimed plot N.P.K:4.10.8kg	39.59	19.41	18.28
N.P.K: 4.10.8kg (60×10cm)	39.59	19.69	17.66
Compost: 1,000kg	40.20	21.08	17.74
Compost: 1,000kg+N.P.K: 4.10.8kg	38.49	18.17	18.39
N.P.K: 2.5.5kg	40.57	20.18	17.07
Non-fertilizer	38.99	18.11	17.63
F value	2.41	1.75	0.63

As shown in table 3 the grain yield was considerably high by 434.7kg/10a in the cultivated plot. In the reclaimed plot high significance was estimated at the 1 percent level in grain yield among treatments of which the plot of N.P K: 4.10.8+compost: 1,000kg/10a produced the highest yield. The lowest yield was obtained in the non-fertilizer plot as the Shoshin K. reported [6] Of the plots of N P K: 4.10.8kg/10a the large population plot (60×10cm) produced somewhat higher grain yield than normal population one(60×20cm). However, no statistical significance was detected between the two population sites. Plant height, stem weight, pod number per plant and weight of 100 grains which

have been considered to bo highly concerned with grain yield had a tendency proportional to grain yield.

3. Grain chemical composition.

The grain chemical composition analyzed is presented in table 4. Much more protein and fat content were noticeable in the cultivated plot while carbohydrate was shown greater in the reclaimed plot than the cultivated one. There were not significant differences among treatment in protein, carbohydrate and fat content. However, protein and carbohydrate tended to be greater on the fertilizer plot than on the non-fertilizer plot. The maximun values of protein and carbohydrate occurred in the compost plot.

Table 5. Correlations among soybean characters grown in reclaimed area.

Characters	Grain yield	100grain wt.	Pod No.	Stem wt.	Stem length	Protein	Carbohydrate
100 grain wt.	0.968**						
Pod No.	0.983**	0.683					
Stem wt.	0.959**	0.774	0.493				
Stem length	0.869**	0.824*	0.477	0.987**			
Protein	−0.085	0.020	−0.316	−0.067	−0.118		
Carbohydrate	−0.583	−0.593	−0.556	0.551	−0.605	0.530	
Fat	0.355	0.0193	0.573	0.443	0.285	−0.210	0.554

The correlations between grain yield and pod number or stem weight were exculuded in the plot of narrow space (60×10cm).

4. Relationships among agronomic traits.

The main traits closely related to the grain yield were 100 grain weight, pod number, stem weight and plant height in which there were positive correlations. The relationships among main traits were shown in table 5. Although there was not a significant correlation between chemical composition and grain yield, a negative correlation was observed between protein and carbohydrate content as the Harue T. and Hirokadu T. reported[1] while a positive correlation between protein and fat. The fact that there was a positive correlation(1 percent level) between plant height and stem weight is believed to be a reasonable result. Fven though positive relationship was found between protein and carbohydrate, a negative relationship was estimated between protein and oil. But there were not significant difference among chemical components.

SUMMARY

In order to know the effect of fertilzer application on the soybean culture in reclaimed land, five rates of fertilizer application(N.P.K: 4.10.8, N.P.K: 2.5.5, N.P.K: 4.10.8+compost: 1,000, compost: 1,000kg/10a unfertilized plot) for the reclaimed plots and single application of N.P.K: 4.10.8kg/10a for the cultivated land were used to compare the influences of them. The yield of above-ground green plant, grain yield and protein were presented higher in the cultivated plot than in the reclaimed plot. In the reclaimed plot the grain yield increased with the increment of fertilizer application. The protein and oil content of grain appeared to be greater in the cultivated plot while the carbohydrate had a tendency of increasing in the reclaimed plot. There were positive correlations at 1 percent level among the traits (100 grain weight. Pod number, Plant height, Stem weight) closely related to grain yield. However, no significant differences were found among treatment in the chemical composition of grain.

摘　　要

開墾地에서 大豆를 栽培함에 있어서 施肥의 効果를 究明하기 爲하여 開墾地에는 10a當 N.P.K:4.10.8kg의 施用區를 비롯하여 無肥區를 包含한 6個 處理區를 設置하고 効果를 比較하고저 따로 熟田에다 N.P.K:4.10.8 kg의 施肥區를 設置하여 收量과 成分含量을 調査한 結果를 要約하면 다음과 같다.

1. 開墾地는 같은 水準의 施肥에서도 熟田보다 青刈收量이나 子實收量이 極히 적었고 子實의 蛋白質含量도 적었다.

2. 같은 開墾地內에 있어서는 窒素의 施用量이 많을수록 子實收量이 많았다.

3. 子實成分에 있어서 熟田은 蛋白質과 脂肪含量이 開墾地보다 많았고 炭水化物은 開墾地가 熟田보다 많은 傾向이었다.

4. 開墾地에 있어서 子實成分含量은 處理間에 有意性이 認定되지 않았다.

5. 收量과 密接한 關係가 있는 100粒重, 1株莢數稈長 稈重等은 子實收量과 正의 相關을 나타냈으며 1%水準의 有意性이 認定되었다.

LITERATURE CITED

1. Harue Taira and Taira Hirokadu. 1971. Influence of location on the chemical composition of soybean seeds. J. Crop Sci. Soc. of Japan. vol 40:530-543.
2. O.H. Lon, J.R. Overton et al. 1965. Lime and fertilizer experiments on soybeans. Tenn. Uni. Agr. Exp. Sta., Bull No. 391, 18.
3. O.R.D. 1972. A research institute of plant environment. Reports on research works. 141-164.
4. O.R.D. 1973. A research institute of plant environment. Reports on research works. 83-108, 181-207.
5. Sadao Nagada. 1972. Field crop, soybean from the series of agriculture. Yokendo.
6. Shoshin Konno. 1971. Effect of nutrient element deficiency during the early plant growth stage on the chemical composition of soybean and the seed production. J. Crop Sci. Soc. of Japan