GREEN MANURE AND NPK EFFECTS ON THE YIELD OF SWEET POTATO IN ERODED SOIL

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ABSTRACT

Green manure did not cause any significant effect on most of the yield and yield components of sweet potato variety BNAS-51; a significant decrease in the number of non-marketable tubers was observed. Highly significant differences among fertilizer treatments were obtained for yields of marketable tubers, total tuber yields, and fresh and dry weights of vines, but not for the number of marketable and non-marketable tubers, total number of tubers per plot, and harvest index of sweet potato. The response of tuber and vine yields was attributed to N application. Higher tuber and vine yields were obtained when 60 kg of N with 30 to 60 kg of P and K were applied.

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INTRODUCTION

Crops grown in eroded areas generally have lesser yields partly due to low organic matter and nutrient content of the soil. Usually, an eroded field becomes unproductive because the surface soil is washed out, thus diminishing its fertility. This low fertility becomes a limiting factor in crop production.

To improve soil productivity, leguminous crops may be grown and turned under the soil as green manure at flowering stage. This is done to provide additional nutrient (primarily nitrogen) to the main crop and improve soil tilth. Manuel and Gines (1971) reported that green manure can be used to improve the poor structure of puddled soil. Welch, Nelson and Krats (1951) stated that P from green manure may be more effective than P from inorganic fertilizer probably due to its gradual release during decomposition, the presence of organic acid to maintain its availability, and the formation of certain complex ions.

This study shows the effect of green manure and NPK in the production of sweet potato in areas where the surface soil has been eroded.

MATERIALS AND METHODS

A newly-eroded area (1,440 sq m) where the surface soil had been washed off was plowed and harrowed twice. After the second plowing and harrowing, mungbean seeds were broadcasted on designated areas. The mungbean was placed under at flowering stage and allowed to decompose for 15 days to serve as green manure.

A split-plot arranged in randomized complete block design was used. Green manure was designated as the main plot and fertilizer levels as the sub-plots. The treatments were as follows:

Main plot: Green manure
- G_0 - without green manure
- G_1 - with green manure

Sub-plots: Inorganic fertilizer
- T_0 - (0-0-0)
- T_1 - (30-0-0)
- T_2 - (30-0-30)
- T_3 - (30-30-30)
- T_4 - (60-30-30)
- T_5 - (60-30-60)
- T_6 - (60-60-60)

The experiment was replicated four times with each replication separated by 2 m alleyway.

One cutting of sweet potato (BNAS-51 variety) was planted per hill at 25 cm between hills and 100 cm between rows. The cuttings were planted by burying the base 20 cm deep and allowing 5-10 cm of the shoot above the ground.

The plots were fertilized with one-half of the total amount of nitrogen at planting time and the other half side-dressed one month after planting. All the other recommended cultural management practices for sweet potato were followed.

Four months after planting, plants from the three middle rows of each treatment were harvested. The number and weight of non-marketable and marketable tubers and fresh and dry weight of vines were noted. Yield (t/ha) of tubers was calculated from plot yield.

RESULTS AND DISCUSSION

Number and Weight of Marketable Tubers.

Analysis of variance showed no significant differences in number of marketable tubers due to fertility levels, green manure, and their interaction (Table 1). However, highly significant differences were observed in weight of marketable tubers among fertilizer levels. The average weight of plants with green manure (5.4 kg/plot) was slightly higher than that of plants without green manure (5.1 kg/plot) but this was not statistically significant at 5% level.

Weight of marketable tubers increased with increasing rate of fertilizers. A significant increase in weight of tubers was observed when N was increased from 0 to 60 kg/ha, regardless of the levels of P and K. Although significantly higher yield of tubers was obtained when 60 kg of N with equal amounts of P and K were applied per hectare compared to 30 kg/ha each of P and K, the yield increase did not seem to

Table 1. Effect of applying green manure and fertilizer levels on the yield and yield components of sweet potato grown on eroded soil.

Treatment		TUBER									
		Number/plot			Weight (kg/plot)		Yield				
Green Manure	Fertilizer level (kg/ha)	Market-able	Non-Market-able	Total	Market-able	Non-Market-able	kg/ plot	t/ ha	Vine weight kg/10 hills Fresh	Vine weight kg/10 hills Dry	Harvest Index
Without	0-0-0	23	14	36.5	3.8	0.7	4.4	6.4	6.2	0.5	0.21
	30-0-0	26	10	35.2	4.3	0.6	4.9	7.0	7.1	0.6	0.19
	30-0-30	32	15	46.5	4.1	0.8	4.9	7.0	7.5	0.7	0.18
	30-30-30	26	17	43.2	4.8	0.6	5.4	7.6	7.3	0.7	0.21
	60-30-30	36	12	48.5	6.1	0.6	6.6	9.5	7.8	0.7	0.24
	60-30-60	31	13	43.2	6.1	0.6	6.8	9.6	8.6	0.7	0.22
	60-60-60	36	17	52.5	6.8	0.9	7.7	11.0	10.8	0.8	0.20
	Mean	30	14	43.7	5.1	0.7	5.8	8.3	7.9	0.6	0.207
With	0-0-0	30	9	39.0	4.6	0.3	4.9	7.0	7.2	0.6	0.19
	30-0-0	30	10	39.8	4.3	0.6	4.9	7.1	8.2	0.6	0.19
	30-0-30	26	14	40.0	5.0	0.4	5.4	7.7	8.6	0.6	0.19
	30-30-30	26	11	36.8	4.6	0.4	5.4	7.7	8.6	0.6	0.22
	60-30-30	36	12	48.2	6.2	0.4	6.6	9.5	9.9	0.8	0.21
	60-30-60	26	11	36.5	6.4	0.4	6.8	9.8	9.7	0.9	0.20
	60-60-60	28	10	37.5	6.4	0.4	6.9	9.8	8.4	0.9	0.23
	Mean	29	11	39.7	5.4	0.4	5.9	8.4	8.5	0.7	0.204
	Grand Mean	29.5	12.5	41.7	5.2	0.55	5.8	8.4	8.2	0.65	0.206
	C.V. (a) %	24.33	18.97	21.0	18.68	80.3	21.79	21.4	39.7	15.6	43.9
	C.V. (b) %	32.66	39.4	28.8	27.42	55.5	26.48	26.2	17.4	20.2	28.9
	Green Manure										
	LSD .01	ns	4.49	ns	ns	ns	ns	ns	ns	ns	ns
	.05	ns	2.45	ns	ns	ns	ns	ns	ns	ns	ns
	Fertilizer										
	HSD .01	ns	ns	ns	0.84	ns	0.89	1.27	0.83	0.08	ns
	.05	ns	ns	ns	0.84	ns	0.67	0.96	0.63	0.06	ns

justify application of P and K beyond 30 kg/ha. This suggests that the native P and K were adequate to meet the needs of the crop.

As indicated earlier, soil fertility influenced the enlargement of tubers resulting in weight differences. All these tend to agree with Wang (1975) who cited that N and K influenced more the expansion of potential tubers than initiation of potential tubers while the effect of P was not apparent.

The results also confirmed the studies of Lizondra (1974) and Ilaga (1973) which showed that significant increase in weight of sweet potato was obtained when 60 to 80 kg of N with equal amounts of P and K per hectare were applied.

Number and Weight of Non-marketable Tubers.

The main effects of fertilizer treatments and the interaction between green manure and fertilizer treatments were not significant, although significant differences were observed among green manure treatments at 5% level.

Plots with green manure produced a significantly lower average number of non-marketable tubers (11 tubers) than plots without green manure (14 tubers). This was probably due to the improved physical

and chemical properties of the soil with green manure. Dhar (1972) emphasized that green manure improves the physical properties of the soil, supplies soil nitrogen, and helps utilize and mobilize those nutrients present in the soil.

Generally, the non-marketable tubers from plots without green manure were smaller in size than those tubers from plots with green manure.

No significant differences were observed in non-marketable tubers between green manure and fertilizer treatments and their interaction. Although a slightly higher yield of non-marketable tubers was obtained in plots applied with 60 kg each of N, P_2O_5 and K_2O per hectare than the control plot, the differences were not statistically significant.

The analysis of variance shows very high coefficients of variation obtained for both the main plots and the sub-plots. This could be partly attributed to the inclusion of tubers which suffered pest and mechanical damage into non-marketable tubers regardless of their size. The high coefficient of variation obtained could also possibly be explained by the variability of the experimental area brought about by erosion.

Total Tuber Yield.

The main effects of green manure fertilizer levels and the interaction between green manure and fertilizer treatments were not significant. Differences in number of marketable tubers between treatment means were not also significant. The results suggest that applying green manure and fertilizer did not considerably influence the initiation of potential tubers; instead, they affected the extent of expansion of tubers. The results confirmed the study of Capuno (1977) which found that the role of individual elements was less apparent in tuber initiation than in tuber enlargement.

The analysis of variance shows that the main effects of green manure and its interaction with fertilizer treatments were not statistically significant. However, highly significant differences in total yields were observed among fertilizer levels.

The average total yield of tubers from green-manure plots was slightly higher (8.4 t/ha) than that from plots without green manure (8.3 t/ha). Similar results were obtained from weight of marketable tubers. Yield of tubers significantly increased when rate of N application was increased from 0 to 60 kg/ha at all rates of P and K. There was no significant increase when N was increased from 0 to 30 kg/ha except when both P and K were also applied at 30 kg/ha each. Highest yield of tubers was obtained when 60 kg of N with equal amounts of P and K were applied per hectare. The results confirmed the study of Soriano (1967) on Irish potato which showed that nitrogen caused significant increase in yield of tubers while phosphorus and potash did not influence the yield significantly.

Plots with green manure produced slightly less number of tubers.

Tubers in plots with green manure had heavier weights than that of plots without green manure. This suggests that tubers in green-manure plots were generally larger in size. Fertility level affected the enlargement of initiated tubers, which in turn determined the number of marketable tubers.

Generally, the results seemed to indicate that 60 kg of N with 30 kg of P and K applied per hectare will be adequate to obtain optimum yield of BNAS-51 in eroded soil under ViSCA conditions. The yield levels obtained in this study were considered very low (10.4 t/ha) compared to the tuber yield in lowland field previously planted to rice (14.42 t/ha) and in upland fields (16.63 t/ha) as observed by Capuno (1977) and Lizondra (1974), respectively. This may be attributed to the poor physical structure and low organic matter content of the soil as a result of the removal of the top soil.

Fresh and Dry Weight of Vines (kg/ 10 hills).

No significant differences were observed between green manure and the interaction between green manure and fertilizer treatments for both fresh and dry weight of vines. Significant differences were observed among fertilizer treatments. The highest fresh and dry weights of vines were obtained from the 60-60-60 treatments and significantly lowest weights in the control and 30-0-0 treatments.

Generally, the weight of vines followed the same trend with that of the total tuber yield. Yield of vines increased with increasing rate of fertilizer. The increase in weight was primarily due to N application and only slight increases were noted due to P and K. Similar results were reported by Wang (1975) who found that yield of sweet potato vines responded well to nitrogen but not to phosphorus and potash. The results also agreed with the study by Banaag (1958) on taro which indicated that vegetative parts were directly affected by nitrogen levels.

Although not significantly different, plots with green manure produced slightly heavier weight of vines (fresh and dry) than plots without green manure. This difference in vine weights between green manure treatments was probably due to the extra nitrogen derived from green manure in addition to the improvement of the physical and chemical properties of the soil. Mercado (1954) also reported that nitrogenous materials such as green manure increased the production of sweet potato vines.

Despite the large differences in fresh and dry weights of vines between treatments, the moisture content was practically the same. The results suggest that fertility level had no effect on the succulence of the plant tissue.

Harvest Index.

No significant responses were obtained between green manure, among fertilizer treatments, and the

interaction between green manure and fertilizer treatments. This indicates that the level of productivity of the soil did not affect the efficiency of the plant in producing excess photosynthates in the form of storage roots or tubers. Similar effects on the treatments were exhibited on vine and tuber production.

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