EFFECT OF STAGE OF DECOMPOSITION OF GREEN MANURE ON THE GROWTH AND YIELD OF SWEET POTATO

Pablito L. Sevenorio and Rodolfo G. Escalada

Former undergraduate student and Associate Professor, Department of Agronomy and Soil Science, Visayas State College of Agriculture, Baybay, Leyte, Philippines.

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ABSTRACT

The use of either soybean or mungo as green manure crop did not significantly affect the agronomic characters, yield and yield components of sweet potato except the number of marketable tubers. Stage of green manure decomposition greatly influenced vine length and leaf area index during the second and third months of sweet potato growth including the length and diameter of tubers, weight and number of marketable tubers/ha, total tuber yield, and harvest index. No significant effects on fresh and dry weights of vines as well as number and weight of non-marketable tubers were noted. Higher yield was obtained when sweet potato was planted 21 days after soybean residue had been plowed under the soil.

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KEY WORDS: Green manure. Stage of decomposition. Agronomic characters. Harvest index.

INTRODUCTION

Due to high cost of inorganic fertilizers, various attempts have been made to utilize organic forms of fertilizer through green manuring. Green manuring conserves soil nitrogen by utilizing this nutrient which would otherwise be leached. It also supplies nutrients to the soil where decomposition and subsequent mineralization have taken place. Bachman and Brady (1976) said that green manure application not only activates some of the soil microorganisms which can provide essential nutrients to plants but also improves soil tilth.

Certain crop management practices that would allow plants to fully utilize the benefits of green manuring are not definitely established. For instance, the right time to plant a crop after the green manure has been plowed under for maximum production has not been fully explored. This is true with root crops like sweet

potato. The common practice is to plant this crop 2 weeks after the green manure has been incorporated into the soil. However, previous studies revealed that this practice has not significantly increased tuber yield.

Martin et al. (1976) reported that crops planted immediately after plowing under the green manure suffer from nitrogen deficiency because microorganisms utilize the nitrogen from the green manure during decomposition. Moreover, toxic substances such as organic acids and gases released during decomposition cause yellowing of leaves and stunting of the seedlings although the crop recovers after the green manure has totally decomposed. On the other hand, Millar et al. (1958) mentioned that green manure when properly applied increases the yield of succeeding crops.

In some field crops like corn, Aala and Gonzales (1965) found that the use of green manure, irrespective of inorganic fertilizer applied, increased the yield by 2.64 to 6.50 cavans/ha. No residual effect of green manure was observed during the second cropping. Eusebio and Umali (1952) observed that leaves of green manured corn were distinctly darker in color than those in the control plots.

Ramos (1968) studied the effect of legumes as green manure on the growth and yield of glutinous corn. There were significant differences in the growth and yield of corn as well as in the length, weight, and diameter of the ears. However, no significant differences were noted in the number of ears harvested per treatment. Peanuts and soybeans used as green manure resulted in the best growth and yield of corn.

This study was conducted to determine the best time to plant sweet potato after plowing under the green manure and to evaluate the relative values of soybean and mungo as green manure crops on the growth and yield of sweet potato.

MATERIALS AND METHODS

The experiment was laid out in an area of 680 sq m using split-plot arranged in a randomized complete block design with 3 replications. The legumes used as green manure (mungo and soybean) were designated as the main plots and the timing of sweet potato planting after incorporation of the green manure in the soil (7, 14, 21 and 28 days after the green manure had been plowed under) as the subplots. A treatment with no manure application (control) was also included.

Mungo (MC-50A) and soybean (TK-5) seeds were sown at specific plots at the rate of 29 and 30 kg/ha, respectively. These legumes were planted at 7-day interval starting with the T_5 plot (28 days after green manure application) so that the planting of sweet potato could be done at the same time for all treatments. Proper timing in planting the green manure crops was observed so that the plants could be plowed under during flowering stage of both crops.

Healthy tip cuttings of sweet potato (BNAS-51) about 30-35 cm long were planted on ridges at the rate of one cutting per hill. Planting distance

was 100 cm between rows and 25 cm between hills, with a population of 40,000 plants/ha. Planting of sweet potato was done at the same time in all treatments, after the planting of green manure has been adjusted accordingly.

Cultivation, handweeding, and control of insect pests and diseases were uniformly done in all plots. The first 2 operations were accomplished with the use of bolos and shovels. Azodrin and Benlate at the rate of 2 tbsp/gal of water were sprayed at two-week intervals to control insect pests and diseases, respectively. Irrigation was done whenever necessary.

All plants in the 2 middle rows of every plot, excluding the end plants in each row were harvested. The harvested tubers were washed, air-dried, sorted, and then weighed.

RESULTS AND DISCUSSION

Green Manure

The fresh weights of vines of the 2 legumes were recorded before they were plowed under the soil. Soybeans produced greater amount of herbage per plant (4.16 t/ha) than mungo (3.69 t/ha).

Before planting sweet potato, the degree of green manure tissue decomposition was arbitrarily determined. Twenty-five per cent tissue decomposition was distinctly noted 7 days after plowing under of green manure, 50% decomposition 14 days after, 75-85% decomposition after 21 days, and 100% tissue decomposition 28 days after incorporation of green manure in the soil.

Agronomic Characters

Sweet Potato

Length of Vines (cm)

The application of green manure and its stage of decomposition significantly affected vine length during the second and third months of sweet potato growth (Table 1). Regardless of the source of green manure, sweet potato planted 21 days after the legumes were plowed under had more vigorous growth than in the other treatments as evidenced by longer vines that developed. However, the other treatments eventually recovered toward the end of the growth period. Martin et al. (1976) reported that a crop planted immediately after green manure decomposition in the soil suffers nitrogen deficiency, yellowing of leaves, and stunted growth due to utilization of available N by soil microorganisms. Toxic substances such as organic acids and gases released during the process of decomposition also affect plant growth. However, recovery of the crop was observed after the green manure had totally decomposed.

Leaf Area Index (LAI)

There was a linear increase in the leaf area index from the first until the third month but it tended to decrease thereafter until harvest (Table 1). The stages of green manure decomposition significantly affected this parameter on the second and third months during which the plants attained their

Table 1. Agronomic characteristics of sweet potato as influenced by stages of decomposition of green manure and averaged across the 2 sources of green manure.

Stage of Decomposition (days)	Length of Vines (cm)				Leaf Area Index (LAI)				Fresh Weight of Vines (t/ha)	Dry Weight of Vines (t/ha)
	Month				Month					
	1st	2nd	3rd	4th	1st	2nd	3rd	4th		
T_1 (control)	90.9	162.9b	238.0a	293.8	1.2	1.9c	2.1c	1.9	11.6	1.9
T_2 (7 days)	102.6	186.1ab	272.7bc	307.1	1.2	2.1bc	2.3bc	2.1	12.1	2.0
T_3 (14 days)	90.0	189.0a	282.4ab	300.0	1.3	2.2b	2.5b	2.1	12.4	2.2
T_4 (21 days)	108.2	210.2a	293.0a	311.9	1.5	2.6a	2.9a	2.2	11.8	2.1
T_5 (28 days)	87.7	164.9b	267.5cd	304.4	1.2	2.2b	2.5b	2.1	12.1	2.0

Treatment means within a column followed by a common letter are not significantly different at 5% level, DMRT.

active vegetative growth. The results indicate that regardless of the source of green manure, sweet potato planted 21 days after incorporation of green manure in the soil developed more and bigger leaves than those subjected to other treatments.

Fresh and Dry Weight of Vines (t/ha)

No significant effects of green manure and its stages of decomposition on these parameters were observed (Table 1). The average fresh and dry weights of sweet potato vines (11.43 and 1.97 t/ha) as affected by soybeans as green manure was slightly lower than when mungo was used as green manure (12.41 and 2.17 t/ha). This result indicates that vine weight was not affected whether the crop was planted at the early or late stage of green manure decomposition.

Yield and Yield Components

Size of Tubers (cm)

The green manure crop used did not significantly affect the length and diameter of tubers. However, the different stages of green manure decomposition markedly influenced tuber size. Biggest tubers (12.38 cm in length and 6.30 cm in diameter) developed when the crop was planted at 21 days after soybean was incorporated in the soil. This indicates that tuber size increased as the decomposition period of the green manure was extended up to 3 weeks. However, a marked reduction in size of tubers was noted when the main crop was planted 4 weeks after green manure incorporation in the soil. Significantly smaller tubers were obtained from the control plots. The tubers in plots that received other treatments were intermediate in size (Table 2).

Number of Marketable and Non-marketable Tubers Per Plot

Significant differences were observed on the effects of green manure crops and stages of decomposition on number of marketable tubers per plot but no interaction effect was noted. Plots with soybeans as green manure developed more marketable tubers per plot (35 tubers) than the plots with mungo as green manure (30 tubers). This is because soybeans had more plant residue (4.16 t/ha) than mungo (3.69 t/ha) when plowed under. The difference in the added organic matter content in the soil could have led to varying amounts of nutrients absorbed by the crop.

The number of marketable tubers generally increased as the decomposition process of the green manure was prolonged before planting the main crop. However, a marked reduction in the number of marketable tubers was noted at the 28-day period.

The number of non-marketable tubers was not significantly affected by the green manure crop and stages of green manure decomposition. No interaction effect was likewise observed.

Table 2. Yield and yield components of sweet potato at different stages of decomposition of soybean and mungo used as green manure.

Stage of Decomposition (days)	Length of Tubers (cm)	Diameter of Tubers (cm)	Weight of Marketable Tubers (t/ha)	Number of Marketable Tubers/ha (x 1000)	Weight of Non-marketable Tubers (t/ha)	Number of Non-marketable Tubers/ha (x 1000)	Total Tuber Yield (t/ha)	Harvest Index
Soybean								
T_1 (control)	9.6d	3.7c	2.8d	26.0c	1.1	14.7	3.9d	0.26d
T_2 (7 days)	10.1bcd	4.2bc	5.2bc	48.0a	1.0	18.0	6.2bc	0.35bc
T_3 (14 days)	11.0b	5.1b	6.2b	42.0ab	0.9	15.3	7.1b	0.38b
T_4 (21 days)	12.4a	6.3a	8.6a	42.0ab	0.9	16.0	9.4a	0.44a
T_5 (28 days)	10.8bc	4.0c	4.6bc	37.7b	1.1	15.3	5.9bc	0.34bc
Mean	10.8	4.7	5.5	39.1a	1.0	15.9	5.5	0.35
Mungo								
T_1 (control)	10.1c	3.7b	3.2c	25.0d	1.1	15.0	4.4c	0.27b
T_2 (7 days)	11.0abc	4.0b	4.2bc	33.3c	1.2	27.7	5.5bc	0.31b
T_3 (14 days)	11.3ab	4.3a	5.1b	41.3ab	1.1	16.0	6.2b	0.31b
T_4 (21 days)	11.8a	5.7a	8.3a	42.0a	1.0	23.3	9.4a	0.43a
T_5 (28 days)	10.2bc	3.9b	3.8bc	36.0abc	1.2	17.3	5.8bc	0.30b
Mean	10.9	4.3	4.9	35.5b	1.1	19.9	6.2	0.32
Grand Mean	10.8	4.5	5.2	36.3	1.1	17.9	6.4	0.34
C. V. a (%)	7.8	12.1	6.6	5.2	34.5	27.6	8.6	6.38
C. V. b (%)	8.4	15.5	26.2	12.2	18.6	32.0	20.8	12.60

Treatment means within a column followed by a common letter are not significantly different at 5% level, DMRT.

Yield of Marketable and Non-marketable Tubers (t/ha)

No significant differences were noted in marketable and non-marketable tuber yield as affected by green manure crop, stages of decomposition, and their interaction. Highest marketable tuber yield of 8.56 t/ha was obtained when the crop was planted 21 days after soybean as green manure was turned under the soil. Planting sweet potato at this period appeared to be suitable since the crop probably utilized the available nutrients from the almost totally decomposed green manure. This was manifested by the development of bigger and heavier tubers. Lower marketable tuber yields were obtained from the control plots. The yields were intermediate in the other treatments.

The weight of non-marketable tubers remained more or less the same regardless of the treatment used although sweet potato grown in plots with mungo as green manure produced relatively heavier non-marketable tubers than those plots with soybean as green manure.

Total Tuber Yield (t/ha)

No significant differences were observed in total tuber yield of plots with either soybean or mungo as green manure. However, the different stages of green manure decomposition significantly affected this parameter (Table 2).

Tuber yield generally increased as the period of green manure decomposition was extended up to 21 days. This could be due to the development of more numerous, heavier and bigger marketable tubers. Furthermore, sweet potato plants grown at this stage of green manure decomposition had more vigorous growth than plants grown earlier or later than this period as evidenced by development of longer vines and higher LAI. Plants which grew vigorously had higher total potential photosynthesis that might have led to production of more photosynthates. This condition possibly caused the increase in number and weight of marketable tubers that developed per plant.

Regardless of the treatment applied, low total tuber yields were generally noted in this study compared to the yield obtained from other studies. This was due to excessive rainfall during the growth period of the main crop which affected its vegetative growth and development, and tuber formation.

Harvest Index (HI)

The green manure crop as well as its interaction with stages of green manure decomposition did not show significant effects on harvest index. Highly significant differences were observed in this parameter as influenced by stages of green manure decomposition.

Sweet potato grown with soybean as green manure had higher HI than those with mungo as green manure. However, the magnitude of difference was not high enough to be significant.

Regardless of source of green manure, an increasing trend in HI was

noted as the period of green manure decomposition was extended from 0 to 21 days. HI values tended to decrease beyond this period. This could be attributed to the maximum availability of nutrients, primarily N, derived from fully decomposed green manure which greatly enhanced vegetative growth and development and formation of more tuberous roots. Considering that herbage yields were comparable among stage of decomposition treatments, variation in HI values could be due to difference in total tuber yield.

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