EFFECT OF DIFFERENT LEGUME SPECIES AS GREEN MANURE ON THE YIELD OF CHINESE CABBAGE (PAKCHOI)

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ABSTARCT

Seven different Legume species viz: snake bean (SNB), gutpelacowpea (GIC), velvet bean (VEB), sunnhemp (SUN), common cowpea (CMC), sesbania (SES), and winged bean (WGB) were evaluated as green manure on the yield of pakchoi. Preliminary fresh organic matter yield (FOMY) in the same observation excluding the WGB showed in order of superiority (CMC), (SUN), (GTC), (SES), (VEL), and (SNB), with the FOMY of 5.35, 5.25, 4.33, 4.03, 3.65, and 3.30, t/ha respectively. The yield of the succeeding pakchoi crop when planted on these respective beds showed VEL to be superior followed by SUN, SES, GTC, CMG, SNB, and WGB with the respective pakchoi yield of 37.18, 33.33, 33.03, 33.00, 25.67, 21.08, and 19.37 t/ha. Statistical analysis showed insignificant effect ($P \geq 0.5$) between legume species, however, velvet bean appeared to be the best green manure crop in this observation. Although no soil tests were done to confirm the levels of nutrients, particularly nitrogen provided by respective legumes, a good crop of pakchoi is an indication of the contribution of these legumes to soil fertility.

INTRODUCTION

Background

With the current energy crisis and the consequent increased cost of commercial fertilizers, many subsistence farmers in Papua New Guinea are finding it difficult to grow crops, particularly vegetables, without the use of fertilizers. Some farmers have appreciated the problem and have resorted to the use of organic fertilizers such as compost, and animal manures in vegetable production. However, most farmers find the former difficult to make due to either the lack of knowledge, or lack of necessary materials, or both, while having a negative attitude for the latter let alone touching it. The attitude to any type of animal manure is culturally negative and these are regarded by many as unhygienic and therefore should not be used in growing food crops.

During the Community Agriculture Extension (CAGE) outreach effort in a few villages and squatter settlements in and around Port Moresby, it was observed that brassicas (cabbage family) are among the most common vegetables grown by many backyard vegetable growers of which chinese cabbage (pakchoi) is the most popular. It was also observed that few farmers are realizing the value of chicken manure and are therefore beginning to utilize this material in vegetable production while there are still others who insist on the use of commercial fertilizers despite the high cost.

GREEN MANURING

Green manuring is an ancient practice which is currently common among large commercial farmers while still unknown by many subsistence farmers in the developing countries. The practice involves digging back into the soil of green plants before reaching maturity stage. Green manure crops particularly leguminous plants have the greatest increasing advantages in providing the soil with organic matter thereby increasing nutrient particularly of nitrogen, improved soil structure, aeration, nutrients and water holding capacities, soil pH, and the population of beneficial soil micro-organisms.

This report is an attempt to demonstrate that vegetables such as brassicas could be successfully grown (when followed by a green manure crop), without the use of commercial fertilizers. Among numerous tropical legume species, that are often used either for green manuring or as a cover crop, is velvet bean (VEB) which is very commonly used by subsistence farmers. As a cover crop the VEB has the potential of providing about 30t/ha of fresh organic matter and is capable of yielding an incredible solid cluster of dark-red active nodules each averaging 4 cm in diameter with a total weight of 500 kg/ha.

Subsistence corn growers in South America who commonly use VEB as a cover crop claim that this legume is able to contribute about 4 t/ha more corn when incorporated with commercial fertilizers. The

VEB is also known to be the best choice of legume species for the purpose of rehabilitating depleted land, and also for eliminating serious weeds such as the nut grass.

METHODOLOGY

Seeds were sown on 6 m x 1 m low-raised-bed in a completely randomized block design (CRBD). Four weeks after sowing, population count of the respective legume species were taken using 1 m x 0.5 m rectangular quadrant. The same quadrant was used 3 weeks later for fresh organic matter yield (FOMY) determination.

Eight weeks after sowing, the legumes were manually chopped with a "bush" knife and immediately dug back into the respective beds with digging fork. Three weeks after the digging back of the legumes, the beds were lightly tilled and 4-weeks-old pakchoi seedlings were planted at 0.4 m x 0.3 m (inter-row and intra-row) spacing.

The cabbage was harvested 4 weeks after planting and total and marketable crop yields per bed were recorded. From this data potential pakchoi yields per treatment were computed.

From the sowing of the legume seeds until harvesting of pakchoi, weekly application of water was done using sprinkler irrigation. During the same period manual weeding was done twice for the legumes and once for the pakchoi. The control of small insects was carried out using an organic extract from ripe chilli-fruits with sunlight soap mixture which was fortnightly sprayed before harvest.

Table 1 **Mean Fresh Organic Matter Yield of Different Legume Species**

Legume Species	Mean Number of plants (plants/m²)	FOMY * Kg/bed	FOMY * Kg/ha	Rank
Snake bean	5.33	1.96	3300	6
Gutpela cowpea	19.00	2.6	4330	3
Velvet bean	7.15	2.19	3650	5
Common cowpea	28.33	3.21	5350	1
Sunnhemp	39.00	3.15	5250	2
Sesbenia	265.33	2.42	4030	4
Winged bean	3.00			

* *Fresh Organic Matter Yield*

Table 2 **Mean Yield of Pakchoi in Green Manure Plots**

Legume Species	Yield Kg/bed	Yield t/ha	% Increase in Pakchoi Yield*	Green Manure Ranking
SNB	12.65	21.08	8.84	6
GTC	18.07	30.12	55.49	3
VEB	22.31	37.18	91.94	1
CMC	15.40	25.67	32.52	5
SUN	20.00	33.33	72.07	2
SES	19.80	33.00	70.36	4
WGB	11.62	19.37	0.00	7

* *Taking pakchoi yield in winged bean (WGB) plot as standard*

RESULTS

Table 1 shows plant population of different legume species where sesbania (SES) had the highest mean number of plants per square metre followed by the common cowpea (CMC), while the winged bean (WGB) had the lowest due to its poor establishment.

Fresh organic matter yield data (Table 1) shows CMC to have the highest FOMY followed by the sunnhemp (SUN), than gutpela cowpea (GIC), while the snake bean (SNB) yielded the lowest. No FOMY recording was obtained from WGB due to poor establishment and growth.

When the pakchoi crop was grown on beds that were preceded by respective legume species the yield was highest in velvet bean VEB followed by SUN and SES. Beds that were preceded by WGB yielded the poorest crop of pakchoi.

Table 1 shows that pakchoi yield is obviously not directly related to FOMY of the preceding legume species. The VEB which ranked fifth in FOMY contributed to the highest pakchoi yield, while the CMC and SUN which yielded the first and second highest in FOMY ranked fifth and second respectively in their contribution to pakchoi yield.

DISCUSSION

Plant population in Table 1 shows SES as having the highest number of plants per square meter of land followed by SUN, CMC, GIC, VEB, SNB, then WGB respectively. There was no standard seed sowing rate as reflected in varying plant densities of respective legume species.

Table 1 shows CMC as having the highest FOMY followed by SUN, GIC, SES, VEB, and SNB respectively with the corresponding FOMY of 3.21, 3.15, 2.60, 2.42, 2.91, and 1.98 kg/bed. The establishment of WGB was very poor therefore no FOMY data was recorded from this species.

The SES although had the highest plant population didn't yield as much fresh organic matter, unlike the CMC. This was due to the slow growth rate of the former species wherein by the eighteenth week most of the plants were less than a meter high. Furthermore, high population of this species resulted in plants having weak thin stems with few leaves resulting in low FOMY. The latter species on the other hand reached flowering stage by the eigtheenth week and the individual branches were up to a metre long. More branches meant higher leaf flush resulting in higher FOMY.

The SUN which scored the second highest FOMY also had the second highest plant population. Bulk of the FOMY may have been contributed by the woody part of the individual stems which was obvious during FOMY observation on the eighteenth week. The VEB, SND, and WGB had low populations and consequently yielded low amounts of fresh organic matter.

The highest mean pakchoi yields (Table 2) were obtained from the beds that were preceded by VEB. In order of superiority VEB is followed by SUN, SES, GTC, CMC, SNB, and WGB with the respective pakchoi yields of 22.31, 20.00, 19.80, 18.07, 15.40, 12.65. and 11.62 kg/bed.

Obviously pakchoi yield was not directly related to the amount of organic matter contributed by the preceding legume species. Most probably the difference in pakchoi yields could be attributed to the varying degrees of soil nitrogen contributed by respective legume species.

Preliminary results of this work shows that out of the seven legume species the velvet bean seems to be the best green manure crop which contributed about 92% more benefit (Table 3), most probably due to soil nitrogen, in the yield of pakchoi.

No analysis was done of the soil samples on which the respective legumes were grown, therefore the real cause of the resultant increased pakchoi yields could not be confirmed.

However, pakchoi as belonging to brassica family, is known to have a high demand for nitrogen. Therefore with a good crop of pakchoi that was harvested from this work, nitrogen could be the most important soil nutrient that was contributed by respective legume species, of which velvet bean provided the most.

FURTHER READING

Bunch, R. (1986). Notes on "Green Manure Crops for Small Farmers". *World Neighbours,* Apartado 278-C, Tegucigala, Honduras. Central America. ❑