

Evaluation of purple vetch (*Vicia benghalensis*) as a green manure legume for Irish potato production in Matanya, Central Rift, Kenya.

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Abstract

Purple vetch was evaluated as a green manure legume for the production of Irish potato (*Solanum tuberosum*) in four growing seasons from 2001 to 2002 in Matanya, Central Rift, Kenya. The legume was compared with the recommended fertilizer for Irish potato production in the area, which is di-ammonium phosphate (DAP) fertilizer applied at the rate of 80 kg N and 90 kg P/ha. The farmers' practice for growing Irish potato is intercropping the potato between maize rows spaced 75 cm apart and a few farmers (<10%) apply farm yard manure at the recommended rate of 5.5 t/ha. This practice was also included in the study treatments. As expected the fertilizer treatment gave significantly ($P < 0.01$) higher tuber yields than the intercropping treatment but it was not better than the green manure treatment. The mean annual tuber yield for the two years was 27.2 t/ha for fertilizer treatment, 23.4 t/ha for the legume green manure and only 13.0 t/ha for the farmer practise. Economic analysis showed that intercropping treatment gave a higher gross margin than the other treatments because maize grain fetched a higher price than potato tubers. However, total variable costs were lowest for green manure treatment, which made it an attractive option for farmers who normally do not have much money to purchase inputs like fertilizers and farm yard manure at the beginning of the season.

Media Summary

Green manuring with purple vetch is a viable option for production of Irish potato because it gives comparable yields to recommended fertilizers and smothered weeds.

Key Words

Smallholders, recommended fertilizers, intercropping, gross margin analysis

Introduction

Irish potato (*Solanum tuberosum*) is the second most important staple food crop in Kenya to maize (Maina and Chui, 1999). It is mainly grown in the Kenyan highlands, which includes the areas along the escarpments of the Rift Valley found north and west of Nairobi and on the north eastern-slopes of Mount Kenya. Its productivity has been hampered by declining soil fertility in many parts of the country because the majority of smallholder farmers cannot afford the recommended rate of fertilizers which is 90 Kg P and 80 Kg N/ha (MoARD, 2002). Some farmers use cattle manure to fertilize the potato crop but its quality is low mainly due to poor quality pastures and poor methods of handling and storage (Lekasi et al. 1998). Green manure legumes can play an important role in soil fertility improvement and hence alleviate food shortages in the smallholder farms (Hudgens, 2000). They are effective in providing protective ground cover, conserving soil moisture, reducing erosion, lowering labour costs for weeding and can improve nitrogen and organic matter status in the soil (Lal et al. 1991; Gachene and Haru, 1997; Hudgens, 2000).

The objective of this study was to evaluate purple vetch (*Vicia benghalensis*) as a green manure for production of Irish potatoes in Matanya, Central Rift, Kenya. This legume was among six that were identified by the Legume Research Network project in 1995 as promising for incorporation into the smallholder farming systems. The others were *Mucuna pruriens*, *Neonotonia wightii*, *Crotalaria ochroleuca*, *Lablab purpureus* and *Phaseolus lunatus*. Purple vetch was selected for this study because of its upright growing nature and hence would not compete vigorously for light with Irish potato.

Methods

Study site

The study was conducted at Matanya, located at latitude 00° 03' 12" South and longitude 36° 57' 12" East. Matanya's altitude is 1840 m above sea level and it lies in the rain shadow of the Mt. Kenya and Aberdares ranges. The predominant soil is a vertic Luvisol (FAO, 1990), which is strongly acidic [pH(H₂O) 4.85], low in nitrogen (0.06%), moderate in organic matter (1.49%) and high in total P (80 mg/kg). The rainfall pattern is bimodal averaging 600 mm per annum. The area has two rainy seasons, the March – September rainy season which is termed the long rainy season (LRS) and the October – February season termed the short rainy season (SRS). The farm sizes are small ranging from 1 - 2 ha per household. Intercropping systems are predominant and they include intercropping maize with beans, and maize with Irish potatoes. Amongst the local population, food shortages are common and malnutrition is on the increase because of low food production, a consequence of recent poor rainfall and declining soil fertility. Only about 10% of farmers use farm yard manure and inorganic fertilizers in the area.

Treatments and trial design

The following three treatments were evaluated;

- Intercropping Irish potato with maize and applying farm yard manure at the rate of 5.5 t/ha.
- Growing purple vetch as a green manure for Irish potato in a relay cropping system. P fertilizer was not applied to the vetch.
- Fertilizing Irish potato with DAP fertilizer at the recommended rate of 80 kg N and 90 kg P/ha (MoARD, 2002).

The treatments were laid down in a completely randomized block design and replicated three times. The plot size was 3 x 3 m. Potatoes were planted on ridges spaced 75 cm apart and intra-spacing was 30 cm. Maize var. H511 was planted at a spacing of 75 x 30 cm. In the intercropping treatment, potatoes were planted between maize rows at an intra-spacing of 30 cm. Purple vetch was drilled at the rate of 35 kg/ha between the ridges where potatoes were planted. After harvesting the potato crop, the legume was left to grow until land preparation for the following season when it was harvested and biomass incorporated into the soil as green manure. The study was conducted for four seasons; LRS and SRS 2001, and LRS and SRS 2002.

Results

The annual rainfall during the study period was 730 and 742 mm for 2001 and 2002, respectively, values that were above the long term average of 600 mm per annum. Figure 1 gives monthly rainfall distribution grouped into ten-day periods (pentades). Rainfall was well distributed, with only about 30% of the monthly rainfall pentades received no rain at all and over 63% of the pentades received more than 10 mm of rain (Figure 1).

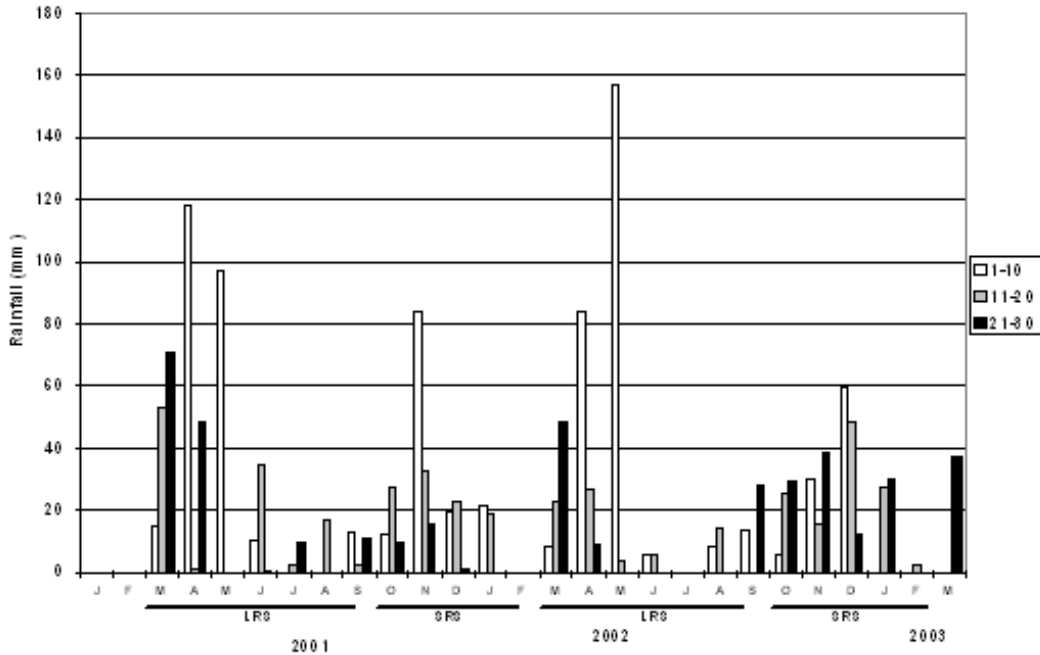


Figure 1: Monthly pentade rainfall distribution for 2001-03 at Matanya, Central Rift, Kenya

The nutrient source treatments affected the tuber yields substantially during the four cropping seasons (Table 1). The high tuber yields from the recommended fertilizer treatment were expected. In 2001 the vetch treatment gave almost similar yields to the fertilizer treatment but the annual total yields in 2002 were depressed by 30%. In all the four seasons, the yields of potatoes from the intercropped treatment were always about half that of the fertilizer treatment. However, since the potato/maize intercropping treatment also produced maize grain, it is only fair to consider the maize when comparing its benefits with other treatments. The mean seasonal maize grain yield was 6 and 3.5 t/ha for 2001 and 2002, respectively.

Table 1: Effect of different nutrient sources on tuber yield of Irish potato in Matanya, Central Rift, Kenya

Nutrient source treatments	Tuber yield (t/ha)					
	2001			2002		
	LRS	SRS	Total	LRS	SRS	Total
DAP fertilizer at the rate of 80 Kg N + 90 Kg P/ha	17.3	10.0	27.3	8.2	19.0	27.2
Vetch as green manure legume (110 Kg N/ha)	15.6	10.7	26.3	7.0	13.6	20.6
Intercropping Irish potato with maize and applying FYM at the rate of 5.5 t/ha (70 Kg N/ha)	9.4	5.1	14.5	3.3	11.5	14.8

F test ^a	n.s.	n.s.	**	n.s.	**	**
LSD (P<0.05)	7.63	5.38	7.45	5.14	4.19	8.50
CV (%)	27.1	31.4	16.4	41.8	13.3	20.4

n.s. - Not statistically significant; ** - Statistically significant at P<0.01.

An economic analysis was conducted to determine the profitability of the three treatments (Table 2). Although potato yield was lowest in the intercropping treatment, its gross revenue and gross margin were the highest compared to the other treatments because they were boosted by the maize grain yield which fetched higher price compared to the potato tubers. The gross margin of the vetch treatment was the lowest but it was only 10 and 13% lower than that of the fertilizer and intercropping treatments, respectively. The variable costs were lowest in the vetch treatment because there were savings on labour for weeding (the legume smothered weeds) and because there was hardly any money spent on transport inputs. The other two treatments required money to transport inorganic fertilizer from market and manure from livestock farmers. To improve and sustain productivity of the vetch over several years, fertilization with P is necessary and a study to evaluate the response of vetch to different levels of P is recommended.

Table 2: Gross margin analysis for the use of different nutrient sources for Irish potato production in Matanya, Central Rift, Kenya

Nutrient sources treatment	Total annual yields* (t/ha)		Gross revenue** (Ksh)	Total variable costs (Ksh)	Gross margin (Ksh)
	Potato	Maize			
DAP fertilizer at the rate of 80 kg N + 90 kg P/ha	27.2	-	182,240	56,320	125,920
Vetch as green manure legume (110 kg N/ha)	23.4	-	156,780	42,200	114,580
Intercropping Irish potato with maize and applying FYM at the rate of 5.5 t/ha (70 kg /ha)	13.0	9.8	194,900	64,870	130,030

* Mean annual potato and maize yields for 2001 and 2002

** Price per ton of potato and maize is Kenya shillings (Ksh) 6,700 and Ksh 11,000, respectively.

Conclusion

The fertilizer and intercropping treatments gave better gross margins than the green manuring treatment but the differences were not substantial. These two treatments have not been adopted by majority of farmers because they lack ready cash to purchase the inputs and transport them to their farms during the beginning of the season. Green manuring with purple vetch is an attractive option because farmers do not need much cash to purchase the inputs and the legume seeds are available locally at a nominal fee.

However, if P fertilizers are required to sustain productivity of vetch then the cost of the fertilizers must be included in the economic analysis.

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