EFFICIENCY OF VARIOUS GREEN MANURES FOR N FERTILIZER SUBSTITUTION AND RESIDUAL EFFECT ON THE FOLLOWING WHEAT CROP

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Field studies were carried out to evaluate various green manuring crops viz. sesbania, guara and sunnhemp and grain legumes viz. mungbean and cowpeas for their biomass production and N contribution to soil. Plant sampling was done at 30, 45 and 60 days after sowing. Maximum plant height and fresh shoot and root biomass were produced by sunnhemp at all the three growth periods but the grain yield and total biomass production at harvest stage (60 DAS) were maximum in case of Pakistani Janter *(Sesbania aculeata)*. The yield of the follow-up wheat crop was also affected significantly by the residual effect of green manures and grain legumes and the maximum wheat grain and straw were recorded from the plots where Pakistani Janter was planted.

INTRODUCTION

Nitrogen and phosphorus are deficient in Pakistani soils and there is hardly any soil from which high yields can be obtained without any fertilization. The production of high inorganic fertilizers requires energy and it is estimated that fertilizer production accounts for about 45% of the energy; used in agriculture worldwide; 73% of which is used for the manufacture of N fertilizer (McCune, 1984). The current energy crisis in the world has enhanced the prices of mineral fertilizers. So it has revived the interests in the use of green manures. The rising interest had led to the identification of some legumes that have high green manuring potential (Alazard and Becker, 1987).

The potential benefits of green manures are many. They increase soil N, concentrate P, maintain and renew organic matter and improve the physical and chemical condition of the soil (Jiao, 1983). The legumes which are used as green manures have high amounts of nutrients and low C and N ratios (range 10-20); 1000 kg of fresh matter contains about 5 kg N, 0.44 kg P and 3.3 kg K (Lizhi, 1988).

Many legume species have been studied and tried as green manure in different countries. Sunnhemp and Dhaincha were the most acceptable to Indian farmers (Meelu and Morris, 1986). Recently *Sesbania rostrata* has been reported as a potential green manuring crop (Rinaudo *et al.,* 1983). Keeping in view the above considerations, the present study was designed to evaluate green manuring crops and grain legumes for their ability to contribute nitrogen and biomass production.

MATERIALS AND METHODS

The experiment was conducted during 1990 in the Research Area of Department of Soil Science, University of Agriculture,

Faisalabad. Representative soil sample from 0-15 cm was analysed for EC_e, pHs and saturation percentage (U.S. Salinity Lab. Staff, 1954), total N (Jackson, 1962), available P (Olsen *et al.*, 1954), organic matter (Walkley, 1947) and textural determination (Moodie *et al.*, 1959) prior to the sowing of green manures/grain legumes. The soil was sandy clay loam with pHs 8.35, EC_e 1.3 dS m^{-1}, organic matter 0.65%, total N 0.03% at 0-15 cm depth and 0.02% at 15-30 cm depth, available P 4.5 mg kg^{-1} and available K 114.5 mg kg^{-1}. The experiment was laid out in Randomised Complete Block Design (RCBD) with three replications, maintaining a net plot size of 5 x 4 m.

Following green manures/grain legumes were evaluated in this study:

1. Pakistani Janter *(Sebania aculeata)*
2. Tropical Janter *(Sesbania rostrata)*
3. Guara *(Cymopsis tetragonolobas)*
4. Sunnhemp *(Crotolaria juncea)*
5. Mungbean *(Vigna radiata)*
6. Cowpeas *(Vigna unguiculata)*

measures were adopted in all the green manures. But there was no fertilizer application to either of the green manure/grain legume. Plant sampling was done at 30,, 45 and 60 days after sowing and data on plant height, fresh root and shoot biomass and effective number of nodules were recorded. The total biomass and grain yield at harvest were also recorded.

The soil after harvest of each crop was analysed for total N content. The residual effect was studied on the followup wheat variety cv. LU 26S where again no fertilizer was applied. The data collected, was analysed statistically according to the procedures given by Steel and Torrie (1980).

RESULTS AND DISCUSSION

The experiment was conducted with the objective to evaluate green manuring/grain legume crops for their nitrogen and biomass production. Data in Tables 1, 2 and 3 reveal significant potential differences

Table 1. Plant height of green manures and green legumes at different growth stages

Green manure/ Grain legume	Plant height (cm)			Mean
	30 DAS	45 DAS	60 DAS	
Pakistani Janter	86 b	112 b	184 b	127.3
Tropical Janter	77 c	120 b	140 c	112.3
Guara	45 e	56 c	60 d	53.6
Sunnhemp	121 a	174 a	207 a	167.3
Mungbean	54 d	57 c	63 d	58.0
Cowpeas	40 e	43 d	38 e	40.3

Means in a column sharing same letter(s) are not significantly different at 5% probability level.

Recommended agronomic practices like irrigation, weeding and plant protection among various green manures/grain legumes in respect of plant height, biomass

Table 2. Fresh biomass of shoot at different growth stages

Green manure/ Grain legume	Fresh biomass (t ha^{-1})			Mean
	30 DAS	45 DAS	60 DAS	
Pakistani Janter	8.43 bc	16.42 bc	20.08 b	17.64
Tropical Janter	9.46 ab	19.52 b	18.42 c	10.83
Guara	6.09 cd	14.25 bc	12.15 d	10.83
Sunnhemp	11.51 a	28.72 a	41.17 a	27.13
Mungbean	6.46 cd	12.26 cd	31.19 b	16.64
Cowpeas	4.58 d	7.51 d	5.40 e	5.83

Means in a column sharing same letter(s) are not significantly different at 5% probability level.

Table 3. Fresh root biomass of green manures/grain legumes at different growth stages

Green manure/ Grain legume	Fresh root weight (t ha^{-1})			Mean
	30 DAS	45 DAS	60 DAS	
Pakistani Janter	0.77 a	2.22 ab	3.44 ab	2.14
Tropical Janter	0.93 a	2.99 a	2.50 b	2.14
Guara	0.45 b	0.84 b	1.47 c	0.92
Sunnhemp	1.02 a	2.93 a	4.18 a	2.71
Mungbean	0.39 bc	0.75 b	1.81 c	0.98
Cowpeas	0.18 c	0.31 b	0.34 d	0.28

Means in a column sharing same letter(s) are not significantly different at 5% probability level.

production of stem and root and grain yields at different growth stages of 30, 45 and 60 days after sowing (DAS). Among all the crops, sunnhemp in plant height and biomass production of shoot remained significantly superior at all growth stages (Tables 1 and 2). But in case of root biomass production, though it was maximum for sunnhemp, yet it was statistically similar to those of tropical and Pakistani Janter at all the growth stages except at 60 DAS where it was statistically higher than that of tropical Janter. However, total biomass and grain yields at harvest (Table 4) showed that Pakistani Janter produced significantly the highest yield. Meelu *et al.* (1985) compared different legume crops for grain production and green manure. They reported that dry matter yields for *Sesbania bispinosa* was the highest among all the crops at 60 days of

growth stage. At harvest, the crops could be statistically ranked according to biomass production and grain yields in the order: Pakistani Janter > Tropical Janter > Sunnhemp. Guara and mungbean yielded least biomass and grains (Table 4).

Table 4. Yield of green manures/grain legumes at harvests

Green manure/ Grain legume	Yield (t ha^{-1})	
	Total biomass	Grain
Pakistani Janter	41.95 a	2.65 a
Tropical Janter	35.34 b	2.18 b
Guara	14.44 d	0.54 e
Sunnhemp	30.69 c	1.19 c
Mungbean	8.43 e	0.93 d
Cowpeas	-	-

Means in a column sharing same letter(s) are not significantly different at 5% probability level.

Nodules, called factories of nitrogen, are the seat of bacteroid, responsible for biological nitrogen fixation. Data on effective nodules plant^{-1} (Table 5) significantly increased as the days after sowing increased in all the crops. However, maximum number of nodules plant^{-1} was observed in Pakistani Janter at all the growth stages. This might be due to the adaptation and early root development of this legume under agro-ecological conditions of the area under study.

Residual effects of these green manures/grain legumes were assessed on the followup wheat crop yield. Wheat straw and grain yields were, though, maximum from plots where Pakistani Janter was planted, yet these were statistically at par with those from the plots where tropical Janter, mungbean were planted (Table 6). Meelu and Morris (1986) obtained non-significant residual effect in the first year of a two years evaluation of 8 green manure crops but in the second year, S. aculeata was the most productive and significantly increased yield of succeeding dry season rice.

Table 5. Number of effective nodules of green manures/grain legumes at different growth period

Green manure/ Grain legume	Plant height (cm)			Mean
	30 DAS	45 DAS	60 DAS	
Pakistani Janter	2.70 a	8.50 a	21.2 a	10.80
Tropical Janter	0.60 b	1.80 b	11.6 b	4.70
Guara	0.00 b	0.00 c	1.4 c	0.46
Sunnhemp	0.03 b	0.07 c	2.2 c	0.77
Mungbean	0.03 b	0.03 c	1.9 c	0.65
Cowpeas	0.00 b	0.20 c	1.3 c	0.50

Means in a column sharing same letter(s) are not significantly different at 5% probability level.

Table 6. Yield of the followup wheat crop

Green manure/ Grain legume	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
Fallow	0.69 d	2.09 c
Pakistani Janter	1.52 a	3.44 a
Tropical Janter	1.38 ab	3.49 a
Guara	1.10 dc	2.59 bc
Sunnhemp	1.19 bc	3.16 ab
Mungbean	1.27 abc	3.13 ab
Cowpeas	0.99 c	2.39 c

Means in a column sharing same letter(s) are not statistically different at 5% probability level.

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