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Root and oil yield of vetiver *(Vetiveria zizanioides)* as influenced by fertilizer management in an intercropping system

S.K. MAHESHWARI[1] AND R.K. SHARMA

College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Indore, Madhya Pradesh 452 001

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ABSTRACT

A field study was conducted in shallow black soils of medium fertility in Malwa region of Madhya Pradesh, during the rainy season of 1994–95 and 1995–96, to evaluate the effect of different fertilizer management on root and oil yield of vetiver (*Vetiveria zizanioides* L.) in intercropping system with redgram or pigeonpea [*Cajanus cajan* (L.) Millsp.] and blackgram (*Phaseolus mungo* L.). Intercropping of vetiver with redgram proved better as redgram gave higher seed yield than intercropping of blackgram with vetiver. Fertilizer application @ 75 kg N + 40 kg P_2O_5/ha to vetiver and 2 kg/ha of *Rhizobium* to the redgram resulted higher net profit of Rs 43,540/ha besides benefit : cost ratio of 2.29.

Key words : Vetiver, Redgram, Blackgram, Rhizobium, Intercropping, Sole cropping, Root slips, Essential oil

Vetiver (*Vetiveria zizanioides* L.) is grown as a vegetative barrier for erosion control in dryland areas. The roots yield an essential oil on hydro-distillation, which is mainly used in high grade perfumery. This grass grows slowly in initial stage and the inter-row spaces virtually remain vacant. Intercrop of legumes enriches the soil fertility by fixing free atmospheric nitrogen thus boosting the growth of the base crop, checks weed growth and gives an additional income from per unit land and time (Pareek and Maheshwari, 1993). Judicious and timely application of fertilizers and manures is essential to improve the crop yield. Neither any work on fertilizer application nor on intercropping of vetiver has been reported so far. A study was initiated for the first time in India to determine the optimum nutritional requirement of Vetiver-based intercropping system under Malwa Plateau of Madhya Pradesh.

MATERIALS AND METHODS

The field experiment was conducted at the College of Agriculture, Indore, during rainy season of 1994–95 and 1995–96. The soil was shallow with 40–50 cm depth belonging to Kamliakheri series Vertic Ustrocrepts (Murthy *et al.,* 1982), low in available N (250 kg/ha), P (21 kg/ha) and rich in K (520 kg/ha). The treatments comprised 2 intercropping systems in 1:1 row ratio, viz. vetiver + redgram and vetiver + blackgram; and 4 fertilizer doses, viz. no fertilizer to vetiver + 2 kg/ha of *Rhizobium* to intercrop, 75 kg N + 40 kg P_2O_5/ha to vetiver + 2 kg/ha of *Rhizobium* to intercrop, 75 kg N + 40 kg P_2O_5/ha to vetiver + 2 kg/ha of *Rhizobium* + 10 kg N + 20 kg P_2O_5/ha to intercrop, 75 kg N + 40 kg P_2O_5/ha to vetiver 2 kg/ha of *Rhizobium* + 20 kg N + 40 kg/ha P_2O_5/ha to intercrop. Eight treatment combinations were compared with sole cropping of vetiver supplied with 75 kg N + 40 kg P_2O_5/ha. Vetiver 'Hybrid 8' was transplanted by root slips during second week of July, followed by redgram 'JA 4' (170 days) and blackgram 'U 19' (65 days). All the crops were sown at 60 cm row and 20 plant spacing and the treatments were laid out in randomized block design with 4 replications. Nitrogen was given in 3 and 2 equal split doses to vetiver and intercrops respectively. Vetiver was irrigated till February–March at 25 days interval. The annual rainfall was 1,366 mm in the first year and 943 mm in the second year. Vetiver roots were dugout 16 months after planting, cleaned and dried under shade and oil percentage was determined by hydro-distillation.

RESULTS AND DISCUSSION

Intercropping of vetiver with redgram and blackgram showed significant yield differences when fertilized with 75 kg N + 40 kg P_2O_5/ha applied to base crop besides 2 kg/ha of *Rhizobium* given to intercrops in 2 crop seasons. In 1994–95 production of vetiver roots was 1,682 kg/ha and intercrop of redgram gave 376 kg/ha grain when 75 kg N + 40 kg P_2O_5/ha was given to vetiver and 2 kg/ha of

Present address : [1]4-A, Krishi Vihar Colony, Indore, Madhya Pradesh 452 018

Table 1. Effect of fertilizer management on root and oil yield of vetiver and seed yield of redgram and blackgram (in parentheses) with their economics

Treatment	Vetiver root yield (kg/ha)			Vetiver oil yield (kg/ha)			Net profit (Rs/ha)	Benefit : cost ratio
	1994–95	1995–96	Mean	1994–95	1995–96	Mean		
Vetiver + redgram								
No fertilizer to vetiver + 2 kg/ha *Rhizobium* to redgram	1,332 (299)	1,607 (1,584)	1,468 (941)	9.51	13.16	11.33	35,730	1.88
75 kg N + 40 kg P_2O_5/ha to vetiver + 2 kg/ha *Rhizobium* to redgram	1,682 (376)	1,891 (1,676)	1,786 (1,026)	11.77	14.37	13.07	43,540	2.29
75 kg N + 40 kg P_2O_5/ha to vetiver and 2 kg/ha *Rhizobium* +10 kg N + 20 kg P_2O_5 to redgram	1,541 (427)	1,930 (1,716)	1,735 (1,071)	11.30	13.12	12.21	40,550	2.13
75 kg N + 40 kg P_2O_5/ha to vetiver and 2 kg/ha *Rhizobium* + 20 kg N + 20 kg P_2O_5 to redgram	1,447 (346)	1,866 (1,721)	1,655 (1,033)	11.34	14.74	13.04	43,490	2.29
Vetiver + blackgram								
No fertilizer to vetiver + 2 kg/ha to *Rhizobium* to blackgram	1,417 (0)	1,866 (277)	1,656 (138)	11.52	15.32	13.42	36,060	1.90
75 kg N + 40 kg P_2O_5/ha to vetiver and 2 kg/ha *Rhizobium* to blackgram	1,864 (0)	1,891 (273)	1,877 (136)	13.69	15.30	14.50	40,360	2.12
75 kg N + 40 kg P_2O_5/ha to vetiver and 2 kg/ha *Rhizobium* + 10 kg N + 40 kg P_2O_5 to blackgram	1,430 (0)	1,896 (376)	1,663 (173)	10.63	13.84	12.23	31,650	1.66
75 kg N + 40 kg P_2O_5/ha to vetiver and 2 kg/ha *Rhizobium* + 20 kg N + 40 kg P_2O_5 to blackgram	1,691 (0)	1,891 (376)	1,791 (188)	12.09	13.23	12.66	33,520	1.76
75 kg N + 40 kg P_2O_5/ha to sole vetiver	1,430	1,883	1,656	10.64	15.06	12.85	32,400	1.70
CD for fertilizer (P=0.05)	261	105	221	NS	NS	NS		
CD for interaction (P=0.05)	NS	NS	NS	NS	NS	NS		

Cultivation cost (Rs/ha), vetiver 15,000; redgram and greengram 4,000
Market rate (Rs/kg): vetiver oil 4,000; redgram and greengram 10

Rhizobium was applied to redgram. This was closely followed by vetiver intercropped with redgram fertilized with 75 kg N + 40 kg P_2O_5 to vetiver, given 1,541 kg/ha of roots and 2 kg/ha of *Rhizobium* + 10 kg N + 20 kg P_2O_5/ha was applied to redgram, gave 427 kg/ha of grains. Significant yield differences were observed during 1995–96 and the higher vetiver root yield of 1,930 kg/ha besides redgram grain of 1,716 kg/ha was recorded at 75 kg N + 40 kg P_2O_5/ha given to vetiver and 2 kg/ha of *Rhizobium* + 10 kg N + 20 kg P_2O_5/ha was applied to redgram (Table 1). The higher mean root yield of vetiver (1,786 kg/ha) and mean grain yield of redgram (1,026 kg/ha) were observed at 75 kg N + 40 kg P_2O_5/ha applied to vetiver and 2 kg/ha of *Rhizobium* given to redgram. This was closely followed by 75 kg N + 40 kg P_2O_5/ha given to vetiver (root yield 1,735 kg/ha) besides 2 kg/ha of *Rhizobium* + 10 kg N + 20 kg P_2O_5/ha applied to redgram (grain yield 1,071 kg/ha).

In 1994–95 intercropping of vetiver with blackgram at 75 kg N + 40 kg P_2O_5/ha given to vetiver and 2 kg/ha of *Rhizobium* applied to blackgram gave significantly higher vetiver root yield of 1,864 kg/ha besides zero yield of blackgram. Significant yield differences in vetiver due to treatments were not observed during 1995–96, though the yield differences were noticed in blackgram fertilized with 10 and 20 kg N + 20 and 40 kg P_2O_5/ha. As such significantly higher mean root yield of vetiver (1,877 kg/ha) was noticed at 75 kg N + 40 kg P_2O_5/ha applied to vetiver and 2 kg/ha of *Rhizobium* given blackgram (136 kg/ha).

During 1994–95 intercropping of vetiver (75 kg N + 40 kg P_2O_5/ha) with redgram (2 kg/ha of *Rhizobium*) gave maximum oil yield of 11.77 kg/ha; whereas in 1995–96 maximum oil yield of vetiver was recorded when vetiver fertilized with 75 kg N + 40 kg P_2O_5/ha besides 2 kg/ha of *Rhizobium* + 20 kg N + 40 kg P_2O_5/ha given to redgram. At par oil yields of 13.07 kg/ha and 13.04 kg/ha were recorded at 75 kg N + 40 kg P_2O_5 given to aforesaid treatment. In case of vetiver+blackgram intercropping system higher oil yields of 13.69 kg/ha, 15.30 kg/ha and mean yield of 14.50 kg/ha were recorded during 1994–95, 1995–96 and in pooled year respectively.

Intercropping of vetiver with redgram gave higher monetary returns of Rs 43,540/ha and Rs 43,490/ha at 75 kg N + 40 kg P_2O_5/ha given to vetiver along with 2 kg/ha of *Rhizobium* applied to redgram and 75 kg N+ 40 kg P_2O_5 given to vetiver +2 kg/ha of *Rhizobium* + 20 kg N + 40 kg P_2O_5/ha applied to redgram respectively. Both the treat-

ments also resulted higher benefit : cost ratio of 2.29. However, in vetiver + blackgram intercropping maximum net returns of Rs 40,360/ha with benefit : cost ratio of 2.12 were recorded at 75 kg N + 40 kg P_2O_5/ha given to vetiver and 2 kg/ha of *Rhizobium* was supplied to blackgram (Table 1).

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