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Integrated Nutrient Management in Forage Based Cropping System (Jowar + Cowpea - Berseem)

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ABSTRACT

Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) under all India coordinated Research Project on forage crop during the year 2005-06 to 2009-10. The field experiment was laid out in Randomized Black Design with three replications on well prepared and leveled field. The seven treatments were randomized in different plots under each replication, using random table. The details of the treatments are given as under control, 100% NPK through inorganic fertilizers (80 kg N + 40 kg P_2O_5 + 20 kg K_2O/ha), 25% N through FYM + 75%NPK through inorganic fertilizers, 50%N through FYM + 50%NPK through inorganic fertilizers,50% NPK through inorganic fertilizers + Biofertilizers (Azotobactor/Rhizobium). 25% N through FYM + 50% NPK through inorganic fertilizers + Biofertilizers (Azotobactor/Rhizobium), 75% NPK through inorganic fertilizers + Biofertilizers (Azotobactor/Rhizobium). Different INM systems caused significant influence on green fodder yield of cowpea intercropped with sorghum. Green fodder yield of sorghum under intercropping system was varied significantly due to different INM systems. The green fodder yield was maximum (435.30 q/ha) T_2 treatment receiving 100% NPK through inorganic fertilizers followed by T_3 plots receiving 75% NPK through inorganic fertilizers and 25 % through FYM and both the treatments proved significantly superior over T_4, T_6, T_7 and T_5 integrated nutrient management systems. The minimum (177.45 q/ha) green fodder yield of sorghum under T_1 treatment receiving no any fertilizers. The mean value of five year experiment revealed that maximum net returns and benefit : cost ratio were obtained under Jowar+ cowpea-Berseem system with 100 % RDF through inorganic fertilizer through by T_7 (25% BF + 75 % RDF) gave Rs. 39839 and B: C ratio 2.16. The minimum net returens and found with T_1 where no application of fertilizer.

Key words: *Jowar, Cowpea, fertilizer, Kharif, Rhizobium*

INTRODUCTION

Among various groups of forage crops, sorghum occupies an important place among the cereals grown in kharif season and leguminous fodders have much concern for sustainable production of quality fodder. Cowpea is an important legume fodder grown during rainy and summer season in semi arid and sub humid tropics of India.

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It provides green fodder to the livestock and is also used for making hay and ensiling with sorghum in order to enrich crude protein and mineral contents. During rabi season among the forage crops, the berseem crop suited well in irrigated areas and provide abundant and nutritious green forage to the animals for long period of time .Integrated nutrient management is the maintenance or adjustment of soil fertility and of plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimization of the benefits from all possible sources of plant nutrient in an integrated manner. The appropriate combination of mineral, fertilizers, organic manures, N-fixing crop varieties according to the system of land use and ecological, social and economic conditions, may be very useful to sustain higher yields of forage crops grown as a pure stand or intercropping system. Adoption of intercropping is one of the ways to get more produce per unit area per unit time. The intercropping cereals fodder with legumes is an effective approach for boosting the production and quality of forage crops. Balasurbamanian, K. and Shaanmugasundaram, V.S., (2002) also advocated the intercropping of legumes with cereals fodder for enhancing the production and quality of the herbage over sole crop of cereals. Nutrient management of an individual crop under sole cropping is easy, but it is complex under intercropping systems. No systematic research evidence has been done for most of the existing intercropping systems. Therefore, it is imperative to evaluate the suitable nutrient management for sorghum and cowpea under intercropping system. Hence, present study has been done to develop suitable nutrient management practice for sorghum and cowpea under intercropping system for Jabalpur conditions. Keeping above facts in view, the present investigation was carried out under All India Coordinated Research Project on Forage Crops, Department of Agronomy at JNKVV Research Farm.

MATERIAL AND METHODS

The site of field experiment was at instructional cum Research Farm, Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) under all India coordinated Research Project on forage crop during the year 2005-06 to 2009-10. The topography of the experiment field was fairly uniform and all facilities for conducting the field experiment were available on the research farm. Jabalpur lies between 22^0 49' to 24^0 8' North latitude and 78^0 21' to 80^0 58' East longitude with an average altitude of 411.78 meters above the mean sea level. Jabalpur belongs to Kymore Plateau and Satpura Hills agro climatic zone as per classification by National Agricultural Research Project.The field experiment was laid out in Randomized Black Design with three replications on well prepared and leveled field. The seven treatments were randomized in different plots under each replication, using random table. The details of the treatments are given as under. The treatment consistent T_1 - control,T_2 - 100% NPK through inorganic fertilizers (80 kg N + 40 kg P_2O_5 + 20 kg K_2O/ha),T_3 - 25% N through FYM + 75%NPK through inorganic fertilizers, T_4 - 50%N through FYM + 50%NPK through inorganic fertilizers,T_5 -50% NPK through inorganic fertilizers + Biofertilizers (Azotobactor/Rhizobium). T_6 - 25% N through FYM + 50% NPK through inorganic fertilizers + Biofertilizers (Azotobactor/Rhizobium), T_7 - 75% NPK through inorganic fertilizers + Biofertilizers (Azotobactor/Rhizobium) Test variety of forage For Sorghum –MFSH-4,For Cowpea Russian Gaint, For Berseem - JB-1

RESULT AND DISCUSSION

Plant height

The plant height of sorghum under intercropping system was varied significantly due to different integrated nutrient systems at harvest. The plant height was maximum (234.50 cm) under T_2 treatment receiving 100% NPK through inorganic fertilizers being at par to T_3 treatment (228.74 cm) receiving 75% NPK through inorganic fertilizers and 25 % through FYM and proved significantly superior over other integrated nutrient management systems. Whereas the minimum (131.47 cm) plant height of sorghum under intercropping system was recorded under control plots (T_1).

At harvest the plant height of cowpea intercropped with sorghum also varied significantly due to different INM systems. It was minimum (97.72 cm) under T_1 treatment receiving no any fertilizers. But it was increased appreciably in T_2 treatment (178.40 cm) 100% NPK through inorganic fertilizers being at par to T_3 (170.02 cm) treatment receiving 75% NPK through inorganic fertilizers and 25 % through FYM. The T_6 (155.94 cm) treatment receiving 25% N through FYM + 50% NPK through inorganic fertilizers + biofertilizers (*Rhizobium*) and proved statistically superior other treatments (T_7 and T_5) receiving nutrients in different proportion from different sources.

In Berseem the plant height varied significantly due to different integrated nutrient systems at harvest. The plant height was maximum (52.84 cm) under T_2 treatment receiving 100% NPK through inorganic fertilizers being at par to T_3 treatment (50.26 cm) receiving 75% NPK through inorganic fertilizers and 25 % through FYM and proved significantly superior over other integrated nutrient management systems. Whereas the minimum (38.56 cm) plant height of sorghum under intercropping system was recorded under control plots (T_1).

Leaf :stem ratio

The leaf-stem ratio of sorghum under intercropping system was varied significantly due to different integrated nutrient systems. The leaf-stem ratio was maximum (0.52) under T_2 treatment receiving 100% NPK through inorganic fertilizers being at par to T_3 treatment (0.51) receiving 75% NPK through inorganic fertilizers and 25 % through FYM and both the treatments proved significantly superior over T_3, T_6, T_7 and T_5 integrated nutrient management systems. Whereas the minimum (0.30) L: S ratio sorghum under intercropping system was recorded under control plots (T_1) where nutrients were not applied through any resource

In case of cowpea intercropped with sorghum, the maximum leaf-stem ratio (0.69) was recorded under T_2 treatment receiving 100% NPK through inorganic fertilizers being at par to T_3 (0.66) plot receiving 75% NPK through inorganic fertilizers and 25 % through FYM and both the treatments proved statistically superior over T_3, T_6, T_7 and T_5 treatments receiving nutrients from different sources. While the minimum (0.44) leaf-stem ratio of cowpea was recorded under T_1 treatment.

In Berseem the leaf-stem ratio varied significantly due to different integrated nutrient systems at harvest. The leaf-stem ratio was maximum (0.87) under T_2 treatment receiving 100% NPK through inorganic fertilizers being at par to T_3 treatment (0.82) receiving 75% NPK through inorganic fertilizers and 25 % through FYM and proved significantly superior over other integrated nutrient management systems. Whereas the minimum (0.56) leaf-stem ratio of berseem under intercropping system was recorded under control plots (T_1).

Crud Protein yield

The crude protein yield of sorghum under intercropping system was varied significantly due to different INM systems. The crude protein yield of sorghum was maximum (8.76 q/ha) under T_2 treatment receiving 100% NPK through inorganic fertilizers followed by T_3, T_4, T_6, T_7 and T_5 treatments and proved significantly superior over T_1 treatment, which had minimum (2.92 q/ha) crude protein yield as no nutrients were applied from any resource.

As regard to cowpea intercropped with sorghum also varied significantly due to different INM systems. It was maximum (2.74 q/ha) under T_2 treatment receiving 100% NPK through inorganic fertilizers being at par to T_3 (2.40 q/ha) plots receiving 75% NPK through inorganic fertilizers and 25 % through FYM and both the treatments proved statistically superior over T_4, T_6, T_7 and T_5 treatments receiving nutrients from different sources. Whereas the minimum (1.02 q/ha) crude protein yield of cowpea was recorded under T_1 treatment.

The crude protein yield of berseem was varied significantly due to different INM systems. The crude protein yield of sorghum was maximum (22.35 q/ha) under T_2 treatment receiving 100% NPK through inorganic fertilizers followed by T_3, T_4, T_6, T_7 and T_5 treatments and proved significantly superior over T_1 treatment, which had minimum (9.58 q/ha) crude protein yield as no nutrients were applied from any resource Mani and Duraisami, 2001and Patel and Rajagopal 2002 found similar result .

Green fodder yield

Green fodder yield of sorghum under intercropping system was varied significantly due to different INM systems. The green fodder yield was maximum (435.30 q/ha) T_2 treatment receiving 100% NPK through inorganic fertilizers followed by T_3 plots receiving 75% NPK through inorganic fertilizers and 25 % through FYM and both the treatments proved significantly superior over T_4, T_6, T_7 and T_5 integrated nutrient management systems. The minimum (177.45 q/ha) green fodder yield of sorghum under T_1 treatment receiving no any fertilizers. Different INM systems caused significant influence on green fodder yield of cowpea intercropped with sorghum. The minimum (48.89 q/ha) green fodder yield of cowpea was recorded under T_1 treatment, where nutrients were not applied at all through any resource. But green fodder yield of cowpea was maximum (109.12 q/ha) under T_2 treatment receiving 100% NPK through inorganic fertilizers through inorganic fertilizers being at par to T_3 (97.76 q/ha) treatment receiving 75% NPK through inorganic fertilizers and 25 % through FYM and both the treatments proved significantly superior over T_4, T_6, T_7 and T_5 integrated nutrient management systems. The green fodder yield of berseem was varied significantly due to different INM systems. The green fodder yield of berseem was maximum (973.62 q/ha) under T_2 treatment receiving 100% NPK through inorganic fertilizers followed by T_3, T_4, T_6, T_7 and T_5 treatments and proved significantly superior over T_1 treatment, which had minimum (481.34 q/ha) green fodder yield as no nutrients were applied from any resource. Ahuja and Singh 1990 Durashami, V.P. 2002 and Latha, K.R. and Subbaraman, N. 2001 found similar result.

Effect on economics

The mean value of five year experiment revealed that maximum net returns and benefit : cost ratio were obtained under Jowar+ cowpea- Berseem system with 100 % RDF through inorganic fertilizer through by T_7 (25% BF + 75 % RDF) gave Rs. 39839 and B: C ratio 2.16. The minimum net returens and found with T_1 where no application of fertilizer.

Effect on Soil properties

It is evident from the data that none of the chemical properties viz., soil pH, electrical conductivity (EC), organic content % (OC), and available phosphorus did not much deviated from their initial status after the completion of present experiment under different integrated nutrient management. However, available nitrogen and potash varied due to different INM system. The available nitrogen and potash was minimum under control plots, but it was enhanced under different nutrient management being the maximum under T_4 treatment followed by T_3, T_6, T_7, T_5 and T_2.

Table 1:- Pooled data of five year (from 2005-06 to 2009-10)

Treatment	Sorghum fodder					Cowpea fodder					Berseem fodder					NMR/Rs / year
	GFY (q ha^{-1})	DMY (q ha^{-1})	CPY (q ha^{-1})	Plant height (cm)	L:S ratio	GFY (q ha^{-1})	DMY (q ha^{-1})	CPY (q ha^{-1})	Plant height (cm)	L:S ratio	GFY (q ha^{-1})	DMY (q ha^{-1})	CPY (q ha^{-1})	Plant height (cm)	L:S ratio	
Control	177.45	39.13	2.92	131.47	0.30	48.89	8.65	1.02	97.72	0.44	481.34	67.02	9.58	38.56	0.56	7225
RDF of NPK	435.30	107.17	8.76	234.50	0.57	109.12	20.52	2.74	178.40	0.69	973.62	146.62	22.35	52.84	0.87	47189
25% FYM+ 75% RDF	418.16	99.84	8.02	228.74	0.51	97.76	18.10	2.40	170.02	0.66	929.36	137.38	20.77	50.26	0.82	36077
50% FYM+ 50% RDF	414.32	99.55	8.03	223.42	0.53	98.38	17.93	2.39	166.22	0.65	933.94	139.06	20.92	50.58	0.83	34208
50% BF+ 50% RDF	341.34	79.78	6.14	203.72	0.39	76.23	13.63	1.75	149.38	0.54	766.22	111.28	16.36	45.39	0.71	27487
50% BF+ 25% RDF+ 25%BF	382.74	89.84	7.14	214.82	0.45	88.19	16.14	2.11	155.94	0.58	829.64	121.52	17.99	46.38	0.76	30442
25% BF+ 75% RDF	382.98	91.28	7.25	212.36	0.45	88.84	16.24	2.01	162.18	0.61	902.54	132.56	19.83	47.62	0.79	39839
SEm± (q ha^{-1})	12.03	3.37	0.30	7.65	0.025	3.74	0.76	0.10	3.56	0.013	20.03	3.28	0.55	0.79	0.015	1731.46
CD 5% (q ha^{-1})	35.14	9.83	0.89	22.35	0.074	10.91	2.24	0.30	10.39	0.040	58.46	9.59	1.61	2.32	0.046	5053.80
CV%	7.38	8.69	9.93	8.21	12.48	9.63	10.82	11.42	5.16	5.22	7.39	6.01	6.78	8.76	9.59	12.18

Table 2. Economics of the treatments

Treatments	Cost of cultivation (Rs/ha)	GMR (Rs/ha)	NMR (Rs/ha)	B: C ratio
T_1	30548	39251	8703	1.25
T_2	37783	87005	49222	2.30
T_3	42886	81875	38989	1.90
T_4	45465	84897	39432	1.86
T_5	35392	63910	28518	1.80
T_6	39820	74380	34560	1.86
T_7	35838	77654	41816	2.16

Table 3. Balance sheet of INM (2009-10)

	Initial status (2008-09)			Total uptake system			Balance			Pooled data (Balance Sheet)		
	N	P	K	N	P	K	N	P	K	N	P	K
T_1	259.3	16.1	395.0	222.9	26.3	188.0	136.4	126.8	247.0	154.6	113.6	228.3
T_2	263.8	16.5	409.0	550.5	90.4	493.7	-186.7	46.1	-44.7	-143.7	38.0	-128.0
T_3	265.5	16.8	415.0	520.1	83.7	464.4	-154.6	53.1	-25.3	-119.1	36.5	-86.4
T_4	278.3	17.8	422.5	575.9	105.4	570.3	-197.6	32.4	-147.8	-145.4	35.1	-155.3
T_5	264.4	16.6	407.0	380.9	52.9	321.6	-16.5	83.7	125.4	05.0	78.5	66.5
T_6	266.3	16.7	408.5	457.3	69.0	398.9	-91.0	67.7	49.6	52.0	64.5	-28.1
T_7	268.2	16.9	407.5	476.4	73.4	407.8	-108.2	63.5	39.7	-87.1	58.9	-55.8

Balance = (Initial status+ added fertilizers – uptake)

Table 4. Soil Fertility status

Treatment	pH	EC ds/m	00%	Available (kg/ha)		
				N	P	K
T_1	7.7	0.53	0.45	208.2	15.1	380.5
T_2	7.5	0.50	0.58	262.3	16.5	408.5
T_3	7.4	0.49	0.60	268.2	16.8	412.5
T_4	7.4	0.48	0.62	286.5	18.2	430.5
T_5	7.5	0.49	0.49	250.6	16.0	405.0
T_6	7.6	0.51	0.58	260.4	16.8	410.5
T_7	7.6	0.51	0.49	252.5	16.6	406.2
Initial	7.4	0.49	0.50	227.0	16.2	395.0

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