Forage Res., **38** (3) : pp. 177-181 (2012) **http://forageresearch.in**

EFFECT OF ORGANIC FARMING ON DRY FODDER YIELD, GRAIN YIELD, NET RETURNS AND SOIL SFERTILITY IN MUNG BEAN-WHEAT (TALL) PRODUCTION SYSTEM

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(Received : 18 June, 2013, Accepted : 25 July, 2013)

SUMMARY

A field experiment was conducted during the year 2005-06 and 2006-07, at research farm of CCS Haryana Agricultural University, Hisar to study the effect of organic farming on dry fodder yield, grain yield, net returns and soil fertility in mung bean-wheat (tall) cropping system. The results indicated that application of 1/3 N each applied in form of FYM + vermicompost + neemcake + NP bio fertilizers recorded highest dry fodder yield (5646 and 4738 kg/ha for mung bean and wheat), mean wheat equivalent yield (3294 kg/ha), net return (Rs.13391 & Rs. 21545/ha), B:C (2.39 & 2.44) and profit (Rs. 98.03 and Rs. 122.63/ ha/day) as compared to other organic sources of nutrients during both the years of study. Application of 100 per recommended fertilizer dose (RDF) performed better among all the treatments. Soil fertility parameters i.e. Organic carbon, available nitrogen and available potassium was better after the harvest of mung bean crop than after the harvest of wheat tall crop.

Key words : Cropping system, economics, organic and inorganic sources

Mungbean [(*Phaseolus radiatus* (L.) Wilczek)] – wheat (*Triticum aestivum* L. emend. Fiori & Paol.) cropping system has a great potential in the northern plains zone of india, comprising Punjab, Haryana, Western Uttar Pradesh, Delhi, parts of Rajasthan and Madhya Pradesh .The legume-wheat system has emerged as a good alternative of rice-wheat , both as a part of crop diversification as well as for maintaining the sustainability of the soils (Verma and Sharma, 2007). As mungbean is a legume and wheat is a cereal, together they complement each other in the cropping system. However, both these crops require better nutrient management practices to express their full potential. The optimum dose of nutrients and their sources play an important role in increasing the productivity of these crops. Integration of inorganic and organic sources of nutrients along with bio- fertilizers is found to give higher productivity and monetary returns in soybean (Bhattacharya *et al*., 2008). Further the organic sources unlike inorganic ones have substantial residual effect on the succeeding crops (Duraisami and Mani, 2001). Introduction of a grain legume in cereal-based cropping system aims at increased productivity and profitability to achieve food and nutritional security and soil sustainability.

The demand for organic wheat and pulses is rising due to enhanced income of people in Haryana and therefore, the need of the hour is to develop organic farming cropping systems including pulses with higher productivity, sustainability and economic viability. The cropping system under study requires less water and chemical fertilizers. Keeping these points in view present investigation was carried out to workout suitable nutrient source for higher productivity, economic returns and soil fertility in mung bean-wheat cropping system.

MATERIALS AND METHODS

The field experiments were carried out during 2005-06 to 2006-07 at research farm of Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana. The soil of the experimental site was sandy loam in texture, low in available N (158 kg ha^{-1}), medium in available P (14.8 kg ha^{-1}) and K (248 kg ha^{-1}) with organic carbon 0.47%. The experiment was laid out in seven strips each measuring 60 m x 5.4 m. The observations were recorded from fixed five sites in each strip. The treatments were T_1: 50% recommended NPK + 50% N through FYM; T_2: 1/3 N each through FYM, vermin compost and neem cake, T_3: T_2 + intercropping

(*Kharif*: Pearl millet; *Rabi*: Mustard), T_4: T_2 + Agronomic practices for weed and pest control, T_5: 50% N through FYM + bio-fertilizer + rock phosphate + phosphate solubilizing bacteria (PSB), T_6: T_2 + NP bio-fertilizers, T_7: 100% recommended NPK (RDF). All the treatments were applied both in mungbean and wheat tall. Recommended dose of fertilizers for mungbean and wheat tall were 20 kg N ha^{-1} + 40 kg P_2O_5 ha^{-1} and 60 kg N ha^{-1} + 30 kg P_2O_5 ha^{-1}, respectively. The nutrient sources, viz. FYM, vermi compost and neemcake were tested for their nutrient constituents and as per the treatments were applied 28 days and 32 days before sowing of mungbean and 18 days and 20 days before sowing of wheat tall, respectively, during both the years. Chemical fertilizers were applied at the time of sowing through drilling method and urea and diammonium phosphate (DAP) were used as sources of N and P, respectively.

Mung bean var. Satya was sown @ 15 kg ha^{-1} in 30 cm row spacing during second and first fortnight of july during both the years of experimentation. Wheat var. C-306 was sown at 22 cm row spacing @ rate of 120 kg ha^{-1} seed in the first fortnight of November during both the years. Pearl millet and mustard yields as inter crop were converted to mung bean and wheat, respectively. Productivity per ha per day was computed by dividing yield of crops by 365 (Katyal *et al*., 1999). Similarly profit per ha per day was also computed dividing net returns per hectare by 365. The system yield (wheat tall equivalent yield) was calculated on the basis of price and yield of both crops. The available nitrogen, phosphorus, potassium and organic carbon were analysed using Alkaline permanganate method (Subbiah and Asija, 1956), Olsen's method (Olsen *et al*., 1954), Flame photometer method (Jackson, 1973) and Walkley and Black's method (Walkley and Black, 1934).

RESULTS AND DISCUSSION

Dry Fodder Yield

Dry fodder, an important and essential component of ruminant diet was recorded highest i.e.6704 and 6580 kg/ha in mung bean; and 7130 and6605 kg/ha in wheat with the application of 100 %RDF in both the crops during 2005-06 and 2006-07. Among organic sources of nutrients, the application of1/3 N each through FYM, vermin compost and neem cake with NP bio-fertilizers recorded highest dry fodder yield of mung bean i. e.5626 and4940 kg/ha and wheat i.e. 4940 and5670 kg/ha during 2005-06 and 2006-07, respectively. The mean yield of mungbean (6642 kg/ha) and wheat (6868kg/ha) was also highest with the application of 100 % RDF. Dry fodder yield (mean of two years) among organic treatments followed the pattern, like that of in 2005-06 and 2006-07 yearly basis.

Grain Yield

In general the grain yield of both mung bean and wheat tall was higher during the year 2006-07 and in the treatment where 100 per cent RDF was applied to both the crops. The highest mung bean and wheat yield (mean of 2-years) of 1199 kg/ha and 2948 kg/ha, respectively was observed with 100 per cent RDF to both crops and it was followed by 50 per cent RDF + 50 per cent N through FYM with 1122 kg/ha and 2385 kg/ha yield of mung bean and wheat, respectively.This

TABLE 1
Effect of organic and inorganic sources of nutrients on dry fodder yield (kg/ha) of mungbean-wheat (tall) cropping system

Treatment	Yield				Mean yield	
	2005-06		2006-07		Mungbean	Wheat
	Mungbean	Wheat	Mungbean	Wheat		
T_1	6380	4930	6350	5195	6365	5063
T_2	4285	4325	5320	4230	4802	4278
T_3	3935	3760	5834	4440	4884	4100
T_4	4249	4350	5550	4045	4899	4198
T_5	3828	3965	3670	3323	3749	3644
T_6	5622	4940	5670	4535	5646	4738
T_7	6704	7130	6580	6605	6642	6868

might be due to efficient and higher partitioning of metabolites and adequate translocation of photosynthates and nutrients to developing reproductive part, leading to higher yield. Shivkumar and Ahlawat, 2008 has also reported similar type of results. Among organic treatments where 1/3 N each through FYM, vermicompost and neem cake was applied along with NP bio-fertilizers recorded highest yield of mung bean (918 kg/ha) and wheat tall (2020 kg/ha). This shows that bio-fertilizers help in increasing the yield of crops.

System Yield (wheat equivalent yield)

The system yield was also highest with the application of 100 per cent RDF to both crops during 2005-06 and 2006-07 and it was followed by the treatment where 50% recommended NPK+50% N through FYM was applied. The system yield (mean of 2-years was 4608 kg/ha with the application of 100 per cent RDF to both crops and was followed by the treatment where 50% recommended NPK+50% N through FYM was applied with yield of 3935 kg/ha. Among organic sources the treatment where 1/3 N each through FYM, vermicompost and neem cake was applied along with NP bio-fertilizers recorded highest yield of 3294 kg/ha. It was lowest (2638 kg/ha) in the treatment where 50% N through FYM+bio-fertilizer+rock phosphate + PSB.

Productivity (kg/ha/day)

Productivity per hectare per day was highest in the treatment where 100 per cent RDF was applied to both crops and it was followed by the treatment where 50% recommended NPK+50% N through FYM was applied during both the years. Productivity (mean of 2-years) was 12.62 kg/ha/day with the application of 100 per cent RDF and 10.78 kg/ha/day with the application of 50% recommended NPK+50% N through FYM. Among organic sources similar to yield of crops and system yield, productivity/ha/day was highest (9.02) in the treatment where 1/3 N each through FYM, vermicompost and neem cake was applied along with NP bio-fertilizers and it was followed by the treatment where 1/3 N each through FYM, vermicompost and neem cake was applied (8.48).

System Economics

Net returns, B:C and profit (Rs./ha/day) were recorded highest in the treatment 100 per cent RDF was applied during both the years under mungbean-wheat tall cropping system. During 2005-06 net returns varied from Rs. 6932 to 35781 per hectare; being highest with the application of 100 per cent RDF. Similar type of results have also been reported by Joshi and Billore, 2004. Among organic sources highest net return of Rs. 13391 was recorded in the treatment where 1/3 N each through FYM, vermicompost and neem cake was applied along with NP bio-fertilizers. Similar trend was observed in 2006-07 in terms of net returns. B:C and profit (Rs./ha/day) were highest with the application of 100 per cent RDF during both the years. Among organic sources B:C and profit followed the same pattern as that in case of net returns.

Soil Fertility Status

Mean per cent organic carbon in soil after mung bean harvest ranged between 0.46 and 0.52. It was

TABLE 2
Effect of organic and inorganic sources of nutrients on yield (kg/ha) of mungbean-wheat (tall) cropping system

Treatment	Yield				Mean yield		Wheat equivalent yield (WEY)			Productivity (kg/ha/day)		
	2005-06		2006-07		Mungbean	Wheat	2005-06	2006-07	Mean	2005-06	2006-07	Mean
	Mungbean	Wheat	Mungbean	Wheat								
T_1	1120	2330	1125	2440	1122	2385	4032	3838	3935	11.04	10.52	10.78
T_2	816	1875	870	1995	843	1935	3115	3076	3095	8.53	8.45	8.48
T_3	786	1800	750	1820	768	1810	2995	3028	3011	8.20	8.30	4.25
T_4	851	1850	855	1950	853	1900	3143	3013	3078	8.61	8.25	8.43
T_5	732	1685	643	1665	688	1675	2811	2464	2638	7.70	6.75	7.22
T_6	928	1970	908	2070	918	2020	3388	3199	3294	9.28	8.76	9.02
T_7	1195	2870	1203	3025	1199	2948	4696	4520	4608	12.87	12.38	12.62

TABLE 3
Effect of organic and inorganic sources of nutrients on economics of mungbean-wheat (tall) cropping system

Treatment	Net income (Rs./ha)		B : C		Profit (Rs./ha/day)	
	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07
T_1	26402	35710	2.06	2.27	72.33	97.84
T_2	10111	19141	1.33	1.59	27.70	52.44
T_3	6932	15516	1.21	1.53	19.00	42.51
T_4	9660	18153	1.31	1.56	26.46	49.73
T_5	9413	12997	1.29	1.47	25.79	35.61
T_6	13391	21545	1.43	1.67	36.69	59.03
T_7	35781	44760	2.39	2.44	98.03	122.63

TABLE 4
Effect of organic and inorganic sources of nutrients on soil fertility status of soil in mungbean-wheat (tall) cropping system (mean of 2-years)

Treatment	Organic carbon (%)		Available nitrogen		Available phosphorus		Available potassium kg/ha	
	Mung bean	Wheat (tall)	Mung bean	Wheat (tall)	Mung bean	Wheat (tall)	Mung bean	Wheat (tall)
T_1	0.48	0.48	187.65	179.90	20.00	14.20	254.50	242.50
T_2	0.51	0.48	189.70	166.60	21.60	14.00	269.00	265.00
T_3	0.50	0.46	183.40	172.90	20.30	12.40	270.50	274.00
T_4	0.52	0.50	198.10	153.90	22.30	13.60	255.50	259.00
T_5	0.46	0.43	156.40	145.60	20.70	10.40	247.00	228.00
T_6	0.52	0.49	182.00	158.20	20.10	16.20	251.50	272.50
T_7	0.52	0.52	190.40	193.20	22.60	16.40	274.50	290.50

highest (0.52%) and at par in treatments T_4 (1/3 N each through FYM, vermicompost and neem cake + Agronomic practices for weed and pest control), T_6 (1/3 N each through FYM, vermicompost and neem cake + NP bio-fertilizers) and T_7 (100% recommended NPK (RDF)) followed closely (0.51%) by treatment T_2 (1/3 N each through FYM, vermicompost and neem cake) where only organic sources of nutrients were added. In treatment T_1 (50% recommended NPK + 50% N through FYM) the reduction in per cent organic carbon was 7.69 over treatment T_7. While after wheat tall harvest trend in per cent organic carbon remains unchanged i.e it was highest (0.52) in treatment and lowest in treatment T_5 (50% N through FYM + bio-fertilizer + rock phosphate + phosphate solubilizing bacteria (PSB)). Variation in per cent organic carbon was wider after *rabi* crop harvest than after *kharif* crop harvest. Available nitrogen (N) in soil after mung bean harvest was highest (198.10 kg/ha) where agronomic practices were followed for weed and pest control besides 1/3 N each through FYM, vermicompost and neem cake i.e. treatment T_4. It was followed by treatment T_7 and the value was 190.40 kg/ha. The lowest available N was observed in treatment T_5. As we mave from treatment T_4 having highest available N to treatment T_5 having lowest available N, the per cent reduction in available N status in soil was 21.05. While after the harvest of wheat tall the available N status in soil varied between 193.20 kg/ha in treatment T_7 and 145.60 kg/ha in treatment T_5. The per cent reduction from T_7 to T_5 was 32.69; whereas per cent reduction in treatment T_7 over T_1 was 6.88.

After the harvest of mung bean crop the available phosphorus (P) among various treatments varied narrowly between 20.00 kg/ha and 22.60 kg/ha. The available P was lowest in the treatment T_1 and highest treatment T_7. Application of recommended dose of N in mungbean through organic sources i.e. treatment T_2 resulted in 21.60 kg/ha available p. After the harvest of wheat tall available P status in soil among organic treatments varied between 10.40 kg/ha and 16.20 kg/ha being lowest in treatment T_5 and highest in treatment T_6. The per cent variation in available P status of soil between the highest and the lowest values among all the treatments was 24.39. Available potassium (K) status

after the harvest of mung bean crop was highest (274.5 kg/ha) in treatment T_7 and lowest in treatment T_5. In the treatment T_2 the available P status was 269.00 kg/ha. After the harvest of wheat tall the trend with respect to the highest and the lowest available K values remain eths same and it ranged between 228.00 kg/ha and 290.00 kg/ha.

Broadly the fertility status of soil i.e. organic carbon, available nitrogen and available potassium was better after the harvest of mung bean crop than after the harvest of wheat tall crop. So it can be concluded that mung bean crop can be viewed more as a soil fertility improver than as an independent crops grown for their grain output. Similar results were obtained by Kanwarkamla, 2000. Singh *et al.* 1997 also reported that inclusion of legume crop in its cropping system offer special advantage to farmar. Similar results have also been reported by Saroch *et al.* 2005.

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