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Effects of Resource Conservation Techniques and Cultivars on Soil Nutrient Status, Plant Nutrient Content and Yield in Mungbean

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Abstract

A field experiment was conducted during *kharif* season of 2009. The main plot treatments consisted of four resource conservation techniques (RCTs) viz. furrow irrigated raised bed system (FIRBS), conventional tillage (CT), zero tillage (ZT) with 5% wheat residue (WR) and ZT with 30% WR ; and five cultivars MH124, MH125, MH318, MH421 and Satya were kept in sub-plots making twenty treatment combinations, which were tested in split plot design with three replications. Different RCTs had considerable impact on yield of mungbean and also on nutrient content and uptake by the crop. FIRBS resulted into better yield of all mungbean cultivars. N, P and K content and uptake by various mungbean cultivars and also protein content were higher under FIRBS. However, at crop harvest, available N, P and K in the soil were more under ZT 30% WR. Among five mungbean cultivars, MH125 attained more growth and resulted into higher grain yield (909 kg/ha) closely followed by MH124 (865 kg/ha) and Satya (809 kg/ha). N, P and protein content were also higher in MH125 but K content was more in MH124.
Key words : Mungbean cultivars, Resource conservation techniques, Soil nutrient status, Plant nutrient content, Yield.

Mungbean (*Vigna radiata* L. Wilczok) is an important crop in India and in South East Asia. In India, it is cultivated on 3.2 million hectare producing is 0.95 million tones, with an average yield of 304 kg/ha (1). It is grown mainly for its protein rich edible seed. It is also rich in B_1, B_2, C and calcium, phosphorus and potassium (2) besides an excellent source of high quality protein in diet. It enhances soil fertility through biological fixation in association with *Rhizobium* (3), check soil erosion as cover crop and sometimes used as green manure. Being a short duration crop, it fits well in different sequential and intercropping systems. In spite of its great importance, fewer efforts have been made to improve its yield and quality. Its per hectare yield is low as compared with the yield potential of existing cultivars. Various factors responsible for low yield of mungbean at farmer's field include unawareness of farmers about optimum date of sowing, improper planting patterns, insufficient weed control, pest management practices and imbalance use of fertilizers. There is an imminent need to boost up the mungbean production in different states through crop improvement and management options. Sowing of mungbean in rows in flat beds is a common practice. Other planting methods like furrow irrigated raised bed system (FIRBS) and zero tillage have been found effective in solving problems related to weed control, water management energy saving and nutrient management in various crops including

Table 1. Effect of different RCTs and cultivars on yield parameters of mungbean. FIRBS-Furrow irrigated raised bed system, CT-Conventional tillage, ZT5% WR-Zero tillage with 5% wheat residue, ZT30% WR-Zero tillage with 30% wheat residue.

Treatments	Grain yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)
RCTs				
FIRBS	863	2,934	3797	22.6
CT	795	2,792	3587	22.1
ZT5% WR	721	2,676	3397	21.2
ZT30% WR	753	2,690	3443	21.8
CD at 5%	27	70	84	0.6
Varieties				
MH124	865	3,060	3925	22.0
MH125	909	2,981	3890	23.3
MH318	690	2,497	3187	21.6
MH421	641	2,405	3046	21.0
Satya	809	2,922	3731	21.7
CD at 5%	24	96	112	0.5

Table 2. Effect of different RCTs and cultivars on NPK content in grain and straw, and protein content in grain of mungbean.

Treatments	N content in grain (%)	N content in straw (%)	Protein content in grain (%)	P content in grain (%)	P content in straw (%)	K content in grain (%)	K content in straw (%)
RCTs							
FIRBS	3.76	0.60	23.55	0.398	0.151	0.407	1.27
CT	3.74	0.57	23.43	0.386	0.145	0.399	1.26
ZT5% WR	3.73	0.53	23.30	0.370	0.137	0.386	1.22
ZT30% WR	3.74	0.55	23.41	0.378	0.140	0.391	1.24
CD at 5%	NS	0.03	NS	0.006	0.006	0.006	0.03
Varieties							
MH124	3.84	0.63	23.99	0.407	0.160	0.477	1.39
MH125	3.96	0.74	24.79	0.462	0.175	0.450	1.33
MH318	3.65	0.47	22.83	0.355	0.125	0.377	1.24
MH421	3.52	0.43	22.05	0.316	0.112	0.351	1.16
Satya	3.75	0.54	23.44	0.376	0.143	0.325	1.13
CD at 5%	0.03	0.02	0.16	0.007	0.005	0.007	0.04

mungbean (3). FIRBS of planting crops can be a viable technology in reducing water losses. Its other advantages are maximum harvesting and utilization of water under low rainfall, avoidance of temporary flooding, improved drainage under high intensity rainfall, higher nitrogen use efficiency and less lodging (4). No till system and planting of mungbean into in-row residue mulch reduced seed bed preparing cost and duration and energy requirement, and was realized one of the sustainable agricultural system, which produced economically enough mungbean grain yield during summer season (5). Zero tillage has been reported viable in different cropping systems with at least 30% residue retension. But reports on such type of studies in India particularly in mungbean grown in sequence with wheat are very meager. Moreover, per-

Table 3. Effect of different RCTs and cultivars on nutrient uptake by crop of mungbean and nutrient content in soil after harvest.

Treatments	N uptake (kg/ha)	N content (kg/ha)	P uptake (kg/ha)	P_2O_5 content (kg/ha)	K uptake (kg/ha)	K_2O content (kg/ha)
RCTs						
FIRBS	50.0	156.3	7.9	18.8	41.1	164.9
CT	44.8	158.9	7.2	19.9	38.7	166.1
ZT5% WR	41.4	161.5	6.4	20.9	35.7	168.2
ZT30% WR	42.7	165.4	6.7	21.6	36.5	169.7
CD at 5%	1.1	5.2	0.2	0.9	1.0	NS
Varieties						
MH124	51.4	158.8	8.4	19.6	46.7	163.7
MH125	57.8	157.3	9.4	19.1	43.7	166.9
MH318	36.1	161.9	5.6	21.0	33.6	167.2
MH421	32.2	164.1	4.7	21.7	30.2	170.1
Satya	46.2	160.6	7.2	20.2	35.6	168.1
CD at 5%	1.1	NS	0.3	1.6	1.4	NS

formance of different cultivars under zero tillage and FIRBS needs to be studied to identify most suitable variety under specific tillage system since mungbean is catching lot of attention of growers in Haryana.

Methods

The field experiment was conducted at CCSHAU, KVK farm, Faridabad during *kharif* season of 2009. The Faridabad district is located in South East Haryana Trans Gangetic Plain (TGP) zone of the Indo-Gangetic Plain Region (IGPR) of India. The experimental site is situated at an elevation of 198 meters above mean sea level with latitude 27° 62´ to 28°33´ N and longitude of 77°62´ to 77°32´ E in semi-arid, sub-tropical zone. The soil of experimental field was sandy loam in texture having a pH value of 8.1 and 0.43% organic carbon. At sowing, the soil of the experimental field was low in available nitrogen (153 kg N/ha) and available phosphorus (20 kg P_2O_5/ha) and medium in available potassium (178 kg K_2O/ha). The average rainfall was 396 mm received during crop growing season. The experiment was laid out in split plot design clubbing resources conservation technique furrow irrigated raised bed system (FIRBS), zero tillage with 5% residues of wheat (ZT 5% WR), zero tillage with 30% residues of wheat (ZT 30% WR) and conventional tillage (CT) in main plots and five cultivars of mungbean (MH125, MH124, MH318, MH421 and Satya) in sub-plots with three replications. Sowing in flat bed planting was done with seed cum ferti drill keeping row to row distance of 30 cm. Whereas, in bed planting, beds were first made in well prepared bed with one pass of bed planter followed by sowing of crop in three rows per bed (90 cm wide). Sowing in zero-till plots was done w1ith zero till fertilizer seed drill keeping row to row spacing of 30 cm.

The crop was sown on July 17, 2009 using seed rate of 15 kg/ha. Gap filling and thinning was done at 5 and 13 days after sowing (DAS), respectively. The weeding was done with the help of hand hoe (*kasola*), first at 20 DAS and second at 40 DAS. All others agronomic practices were kept normal and uniform across treatments.

Data on grain yield, straw yield, N, P and K content and uptake of straw and grain, and protein content of grain were recorded. The soil samples were tested before sowing and after harvesting for determining the soil texture, available nitrogen, phosphorus, potassium, soil pH, EC and organic carbon. Data collected during the study were statistically analyzed by using the technique of analysis of variance (ANOVA) and to judge the significant difference between means of two treatments at 5% probability level was employed.

Results and Discussion

Yield Parameters

FIRBS produced significantly more grain yield, biological yield, straw yield and harvest index compared to other treatments but was at par with CT in harvest index (Table 1). Comparison and trend among the mean crop value for straw yield for the FIRBS, CT, ZT 5% WR and ZT 30% WR and five cultivars were very similar to response for grain yield. This might be due to more plant stand, pods number per plant, number of grains per pod and test weight in FIRBS compared to other treatments. This also might be due to avoidance of water logging under FIRBS which could be the principal reason for better performance of mungbean. This also might be de to well prapared seed bed. Similar effects of modified land configuration (5, 6) in pigeonpea have also been reported. Grain, straw and biological yield and harvest index of mungbean were not influenced by RCTs (3). In contrast, dry bean yield was higher with ZT than CT in wheat stubble in 2004 (Blackshaw et al. 2007). Within the no-till system, soybean seed yield declined as the amount of wheat residue increased (7). But under present investigation, grain yield of mungbean under ZT 30% WR was more than ZT 5% WR.

The cultivar MH125 gave a higher grain yield than other cultivars. This was possibly de to more number of pods per plant, grains per pod and plant stand. There was no cultivar × tillage interaction in grain yield. The cultivar MH124 was next in the sequence which gave higher biological and straw yield than other cultivars.

Nutrient Content and Uptake by Crop

There was no significant difference in N and protein content in grain under different RCTs (Table 2). Similarly, Kumar et al. (3) also reported that RCTs did not bring about significant variation in terms of N content in mungbean. The different RCTs influenced the N content in straw significantly. This might be due to more vegetative growth occurred at harvest compared to reproductive growth at time of maturity due to high rain so N content in straw was higher due to higher uptake of N content in FIRBS compare to other treatments. N content (grain and straw) and protein content in grain significantly influenced by cultivars of mungbean. This might be de to their genetic variation. P and K in grain and straw were higher in crop grown under FIRBS compared to other treatments. This might be due to more uptakes of these nutrients (Table 3). Maximum P content in straw and grain was found in MH125 and lowest values were obtained in MH421. Maximum K content in grain and straw was found in MH124 and lowest values were obtained in Satya. This might be due to genetic variation in different cultivars (Table 2).

The N, P and K uptake by the crop under FIRBS was comparatively higher (Table 3). This might be due to more vigorous root growth of mungbean under FIRBS than other treatments. There was significant cultivar variation in N, P and K uptake in mungbean (Table 3). N and P uptake was higher with MH125 due to better root growth and better establishment compared to other cultivars but K uptake was higher with MH124. This might be due genetic variations which exploit the more K uptake.

Nutrient Status in Soil Parameters at Harvest

N content in soil after harvest of mungbean increased obviously due to N fixation as mungbean is a leguminous crop. Maximum N content in soil after harvest was found in ZT30% WR and lowest in FIRBS (Table 3). After harvest of mungbean, P content also increased in soil in ZT plots. This might be due releasing of fixed P content by wheat residue. In FRIBS and CT plots, P content in soil was decreased due to more uptakes and less release of fixed P content compared to ZT plots with wheat residue. There was no significant effect recorded in N content in soil after harvest due to different cultivars of mungbean. Maximum P content in soil after harvest was recorded with MH318 followed by MH421 and Satya and it was low in plots where MH124 and MH125 were grown. This might be due to high yield potential of MH124 and MH125, better root growth which absorbs more P content from soil compared to MH318, MH421 and Satya. K status in soil after harvest was not significantly influenced by different RCTs and cultivars of mungbean. In contrast, N, P and K status after cowpea harvest was reports higher in ridge and furrow system compared to flat sown (5).

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