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EFFECT OF MOISTURE CONSERVATION PRACTICES AND SOIL AMENDMENTS ON YIELD, UPTAKE OF NUTRIENTS BY SOYBEAN AND FERTILITY STATUS OF SOIL

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ABSTRACT

An experiment was conducted during the *kharif* 2016-17 to study the "Effect of moisture conservation practices and soil amendments on soil properties and yield of soybean in Inceptisols". The experiment was conducted at Integrated Farming System Research, Dr. PDKV, Akola with seven treatments replicated thrice in randomize block design. The treatments consists of RDF (Normal sowing), RDF+ opening of furrow at 30 and 45 DAS with incorporation of glyricidia and vermicompost. The results indicated that the adoption of moisture conservation practices and use of soil amendments significantly influenced by physical and chemical properties of soil. Application of 75% of RDF + FYM @ 2.5 tonnes after opening of furrow at 30 DAS, significantly gave highest yield and enhanced uptake also. Where as 75% RDN and 100% P and K through chemical fertilizer + 25% N through green leaf manuring (Glyricidia) at the time of sowing and opening of furrow at 30 DAS significantly enhanced fertility status of soil and lowered the pH significantly. From the above results it can be stated that the integration of moisture conservation practices and soil amendments have greater significance in improving yield and chemical properties of soil.

(Keywords: Amendments, Inceptisols, glyricidia, green leaf manuring)

INTRODUCTION

In rainfed agriculture, management of soil moisture has great significance considering uncertainty and erratic distribution of rainfall. Soil moisture plays an important role in determining growth and yield of crop, which is directly related to plant water status.

The land configuration techniques are essential for *in-situ* conservation of soil and water. The main aim of these practices is to reduce or prevent either water or wind erosion and to achieve the desired moisture for sustainable crop production. The suitability of any *in-situ* soil and water management practices depend greatly upon soil, topography, climate, cropping system and farm resources. Soil and water conservation can be achieved through cultural or mechanical methods such as tillage operations, contour cultivation, ridges and furrows, broad bed furrows and opening of furrow. It not only aids in reducing the soil runoff losses but also raising rainfed crops more successfully in arid and semiarid regions. *In-situ* soil and water conservation practices improve the physical, chemical and biological properties of the soil and helps to increase crop productivity. Soybean (*Glycine max*. L.) is one of the important oilseed as well as leguminous crop. Soybean as a miracle "Golden bean" of the 21st century mainly due to its high protein (40%) and oil (20%) content and is now making headway in Indian Agriculture (Halwankar *et al*., 1992). In India it is mainly grown as 'oilseed crop'. It is the cheapest and richest source of high quality protein. It supplies most of the nutritional constituents essential for human health. Hence, soybean is called as "Wonder bean" or "Miracle bean". Soybean occupies an intermediate position between legumes and oilseed.

Mulches have beneficial and favourable effect, which results in conservation of soil moisture for a longer period and help in improving the yield attributing characters and ultimately seed yield (Murthi and Rao, 1969; Lal *et al.* 1974; and Mandal and Ghosh, 1984, Mandal and Vamadevan , 1975). The practice of opening furrow in between rows of crop is beneficial for improving drainage system in field during heavy rains. Ridges may serve as micro-watershed accumulating water in furrow. Practice of making ridges by opening furrows may have an advantage in concentration of more rain water on bed which enriches soil moisture content (Gidda and Morey, 1981). Soil moisture stresses and deficient nutrition are two important constraints in crop production. The crop grown under rainfed condition are either subjected to excess water or water deficit conditions. Intermittent spells of drought of 10-15 days or even more are commonly observed affecting growth of crop.

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Green manuring is another improved concept of soil fertility management and being practiced to incorporate the succulent green portion of plants such as leaves, twigs and lopping of trees into soil. Green manuring crop are known to fix atmospheric nitrogen, improve soil structure and recycle the nutrients. Decomposition of organic manure resulting in liberation of CO_2 which influences on weathering of minerals and ultimate release of plant nutrient (Dubey *et al*., 2015). The significance of *in-situ* soil moisture conservation measures is to conserve maximum possible rainwater. Further efficient use of it in different crop stages. Soil management and agronomic practices are tailored to store and conserve as much as rainwater is possible by reducing runoff and increasing the storage capacity. With this view the present investigation was carried out during the year 2016-17.

MATERIALS AND METHODS

The experiment was conducted at Integrated Farming System Research, Department of Soil Science and Agricultural Chemistry, Dr. PDKV, Akola with seven treatments replicated thrice in randomize block design. The treatments consists of RDF (Normal sowing), RDF+ opening of furrow at 30 DAS, RDF+ opening of furrow at 45 DAS, 75% RDN and 100% P and K through chemical fertilizer + 25% N through green leaf manuring (Glyricidia) at the time of sowing and opening of furrow 30 DAS, 75% RDN and 100% P and K through chemical fertilizer + 25% N through green leaf manuring (Glyricidia) at the time of sowing and opening of furrow 45 DAS, 75% of RDF + FYM @ 2.5 tonnes after opening of furrow 30 DAS, 75% of RDF + FYM @ 2.5 tonnes after opening of furrow 45 DAS.

The soil was medium black with pH 7.60 and medium organic carbon. The available nitrogen, phosphorus and potash content of the soil was 185.37, 16.13, 363.84 kg ha^{-1} respectively. The JS-335 variety was sown with seed rate of 75 kg ha^{-1} and fertilizers dose of 30:75:30 kg NPK ha^{-1}. In treatment T_1, T_2 and T_3 full dose of N, P_2O_5 and K_2O kg ha^{-1} was applied and in treatment T_4, T_5, 75% recommended dose of nitrogen was given through green leaf manuring (Glyricidia) at the time of sowing and 100% P and K through chemical fertilizers. In treatment T_6 and T_7, where furrows were opened after 30 and 45 days of sowing and 75% of RDF + FYM @ 2.5 tonnes was applied. The uptake of nutrients was also measured. The electrical conductivity was measured by conductivity bridge method and organic carbon by Walkley and Black (1934) oxidation method. The nitrogen was assessed by following Micro–Kjeldahl's method and distillation with automatic distillation system as described by Piper (1966). While total uptake of phosphorus was measured by using diacid digested plant sample (Nitric: Perchloric acid in 9:4 proportion) with Vanadomolybdate yellow colour solution using colorimeter as described by Jackson (1973). The potassium uptake was calculated using diacid digested plant sample using flame photometer, as described by Piper (1966). Similarly, the soil samples were collected after harvest of soybean and were analysed for available nitrogen, phosphorus and potassium by following alkaline permanganate method as described by Subbiah and Asija (1956) for nitrogen, Olsen's method as described by Watanabe and Olsen (1965) using 0.5 M sodium bicarbonate for phosphorus and neutral N ammonium acetate (pH 7.0) as an extractant by using spectrophotometer as described by Jackson (1973) for potassium respectively.

RESULTS AND DISCUSSION

Yield of soybean

The data indicated in table 1, revealed that the yield of soybean (q ha^{-1}) was significantly influenced by various treatments. Seed and stover yield of soybean was significantly more (Seed 24.81 and stover 34.84 q ha^{-1}) in treatment T_6 where 75 % RDF + FYM @ 2.5 tonnes were applied after opening of furrow 30 DAS, followed by T_4 (Seed 22.06 and 21.97 q ha^{-1}) where 75 % RDN and 100 % P and K through chemical fertilizer 25 % N through green leaf manuring (Glyricidia) at the time of sowing and opening of furrow at 30 DAS was applied. The lowest yield of soybean was found in treatment T_1 (Seed 17.95 and Stover 27.67 q ha^{-1}) where recommended dose of fertilizer was given and any conservation practice was not followed. The opening of furrow 30 DAS and incorporation of glyricidia leaves supported in conservation of moisture, which ultimately helps in developing favourable environment of roots of soybean. The timely availability of moisture and nutrient at specific metabolic processes supported enhancement in seed and stover yield of soybean.

Uptake of nutrients

Nitrogen

The significantly highest total nitrogen uptake was recorded under treatment T_6 (190.5 kg ha^{-1}) where 75 % of RDF + FYM @ 2.5 tonnes and opening of furrow 30 days after sowing was applied , followed by treatment T_4 (163.84 kg ha^{-1}) where 75 % RDN and 100 % P and K was given through chemical fertilizers along with 25 % nitrogen through glyricidia at the time of sowing and furrows were opened 30 days after sowing. The lowest nitrogen uptake was noted in treatment T_1 (128.93 kg ha^{-1}) where recommended dose fertilizers was given. The nitrogen uptake was 36.5% more over treatment T_1. This is in conformity with the findings reported by Chaturvedi and Chandel (2005). They reported that use of organic manures with inorganic fertilizers that has favoured higher availability of nitrogen for higher uptake of nitrogen. Talati *et al*. (2004) stated that the application of N ha^{-1} + 5 t FYM ha^{-1} recorded significantly higher nitrogen and phosphorus uptake by seed and stover of soybean , Shirale and Khating (2009) revealed that the recommended dose of fertilizer and combine application of glyricidia @ 1.5 t ha^{-1} + 25% RDF increased grain yield and NPK uptake by soybean.

Phosphorus

The data pertaining to phosphorus uptake by soybean are presented in table 1. It is reported that the total uptake of phosphorus by soybean was significantly influenced by various nutrient management practices. The significantly highest phosphorus uptake (22.65 kg ha^{-1}) was recorded under treatment T_6 where 75 % RDF and 2.5 tonnes FYM after opening of furrow 30 days after sowing was applied, followed by application of 75 % RDN and 100 % P and K through chemical fertilizer along with 25 % through glyricidia at the time of sowing and furrows were opened 30 days after sowing. The lowest phosphorus uptake by soybean was observed in treatment T_1 (15.76 kg ha^{-1}) where recommended dose fertilizers was given. The similar results were also noted by Chaturvedi and Chandel (2005). They reported that use of organic manures with inorganic fertilizers that has favoured higher availability of phosphorus for higher uptake of phosphorus.

Potassium

The total uptake of potassium was calculated considering the potassium uptake by soybean seed and stover. It was observed that data regarding total uptake of potassium was found statistically significant under different organic treatments. The lowest potassium uptake was noted in treatment T_1, where only recommended dose of fertilizers was given, while the significantly highest total potassium uptake (60.17 kg ha^{-1}) by soybean was observed with T_6 where 75 % recommended dose of fertilizers through chemical fertilizers along with 25 % RDF through FYM and the furrow were opened 30 days after sowing and it was at par with treatment T_4 and T_5 where 75 % RDN and 100 % P and K was given through chemical fertilizers along with 25 % RDN through glyricidia at the time of sowing and the furrows were opened 30 and 45 days after sowing.

The highest increase in potassium uptake was 28.32 % over treatment T_1. Similarly it was also observed that where organic sources were used the potassium uptake was remarkably higher. The similar results were also noted by Chaturvedi and Chandel (2005), they stated that the highest yield attributes (pods $plant^{-1}$, and 100-seed weight), harvest index, grain yield as well as NPK uptake was recorded with the application of 100% recommended dose of NPK + FYM @ 10 tonnes ha^{-1}.

Soil Properties

Soil Reaction

The results in respect of soil reaction are placed in table 2, and it was observed that, the soil pH was slightly lowered due to application of glyricidia at the time of sowing in treatment T_4 (7.45) and T_5 (7.44) where 75 % RDN and 100 % P and K was given through chemical fertilizers along with 25 % RDN through glyricidia at the time of sowing and the furrows were opened 30 and 45 days after sowing respectively. The higher soil pH was noted in treatment T_1 (7.61), where recommended dose of fertilizer was given alone. The pH was reduced to 7.45 and 7.44 in treatment T_4 and T_5 where 75 % RDN and 100 % P and K was given through chemical fertilizers along with 25 % through glyricidia at the time of sowing and the furrows were opened 30 and 45 days after sowing respectively. Other treatments also shown comparable results in respect of soil pH. The similar result also noted by Guled *et al.* (2002), who reported that application of organic manures and inorganic fertilizers resulted in decrease in pH of soil.

Electrical conductivity was slightly lowered (0.22 dS m^{-1}) in treatments where glyricidia was applied at the time of sowing, but it was not significant. The higher electrical conductivity was noted in treatment T_1 (0.25 dS m^{-1}), where any moisture conservation practice was not followed.

In respect of organic carbon, it was observed that, the organic carbon in soil was slightly changed due to application of glyricidia at the time of sowing, but the results were non significant. Comparatively lower value (5.61g kg^{-1}) of organic carbon was reported in treatment T_1, must be due to alone use of inorganic fertilizers .while it was numerically higher in treatment T_2 (5.62 g kg^{-1}), when furrows were opened after 30 days of sowing, similarly it was not improved in treatment T_3 (5.61g kg^{-1}), where recommended fertilizers were given and furrows were opened after 45 days of sowing

Residual soil fertility

The data in respect of available nutrients are indicated in table 3. The available nitrogen status in soil after harvest of soybean varied from 194.85 kg ha^{-1} to 218.68 kg ha^{-1}. The highest available nitrogen (218.68 kg ha^{-1}) was recorded in treatment T_4 where 75% RDN and 100% P and K through chemical fertilizer + 25% N through green leaf manuring (Glyricidia) at the time of sowing and opening of furrow 30 DAS, followed by in treatment T_5 where 75% RDN and 100% P and K through chemical fertilizer + 25% N through green leaf manuring (Glyricidia) at the time of sowing and opening of furrow 45 DAS. The fertility status of nitrogen was also comparable where 75% RDF was given along with 2.5 tonnes FYM and furrow were opened after 30 and 45 DAS which was at par with each other. The lowest value was observed in treatment T_1 with the application of RDF (194.85 kg ha^{-1}). Nawlakhe *et al.* (2009) reported the similar findings in respect of availability of nitrogen by integration of chemical and organic sources of nutrients under Cotton –Green gram rotation.

Similarly the available phosphorus status in soil after harvest of soybean varied from 18.90 kg ha^{-1} to 24.10 kg ha^{-1}. The highest available phosphorus (24.10 kg ha^{-1}) was recorded in treatment T_6, (75% of RDF + FYM @ 2.5 tonnes and furrow opened 30 DAS) followed by treatment T_7 (75% of RDF + FYM @ 2.5 t after opening of furrow 45 DAS).

The available potassium status in soil after harvest of soybean varied from 370.25 kg ha^{-1} to 386.89 kg ha^{-1}. However, the data was statistically significant. The highest available potassium (386.89 kg ha^{-1}) was recorded with 75% RDN and 100% P and K through chemical fertilizer + 25% N

Table 1. Yield (q ha^{-1}) and uptake of nutrients (kg ha^{-1}) of soybean as influenced by different treatments

Treatment No.	Treatments	Seed (q ha^{-1})	Stover (q ha^{-1})	Uptake of nutrients (kg ha^{-1})		
				Nitrogen	Phosphorus	Potassium
T_1	RDF (Normal sowing)	17.95	27.67	128.93	15.76	46.89
T_2	RDF+ opening of furrow at 30 DAS	21.42	30.41	155.93	17.07	53.10
T_3	RDF + opening of furrow at 45 DAS	19.70	29.48	154.61	15.74	49.30
T_4	75% RDN and 100% P and K through chemical fertilizer + 25% N through green leaf manuring (Glyricidia) at the time of sowing and furrow 30 DAS	22.06	31.97	163.84	20.06	58.02
T_5	75% RDN and 100% P and K through chemical fertilizer + 25% N through green leaf manuring (Glyricidia) at the time of sowing and opening of furrow 45 DAS	21.71	30.87	151.86	17.92	54.86
T_6	75% of RDF + FYM @ 2.5 tonnes after opening of furrow 30 DAS	24.81	34.84	190.5	22.65	60.17
T_7	75% of RDF + FYM @ 2.5 tonnes after opening of furrow 45 DAS	21.14	29.52	152.36	19.67	52.50
	SE (m) ±	0.91	1.27	7.55	0.73	1.77
	CD at 5%	2.81	3.92	23.27	3.15	5.47

Table 2. Soil reaction as influenced by soil moisture conservation practices and soil amendments

Treatment No.	Treatments	Soil Reaction		
		pH	EC	OC g kg^{-1}
T_1	RDF (Normal sowing)	7.61	0.25	5.61
T_2	RDF+ opening of furrow at 30 DAS	7.69	0.24	5.62
T_3	RDF + opening of furrow at 45 DAS	7.58	0.24	5.61
T_4	75% RDN and 100% P and K through chemical fertilizer + 25% N through Green leaf manuring (Glyricidia) at the time of sowing and opening of furrow 30 DAS	7.44	0.22	5.64
T_5	75% RDN and 100% P and K through chemical fertilizer + 25% N through Green leaf manuring (Glyricidia) at the time of sowing and opening of furrow 45 DAS	7.45	0.22	5.63
T_6	75% of RDF + FYM @ 2.5 tonnes after opening of furrow 30 DAS	7.53	0.24	5.63
T_7	75% of RDF + FYM @ 2.5 tonnes after opening of furrow 45 DAS	7.52	0.24	5.62
	SE (m) $\pm$	0.049	0.021	0.034
	CD at 5%	0.15	-	-

Table 3. Available NPK (kg ha^{-1}) in soil after harvest of soybean as influenced by different treatments

Treatment No	Treatments	Available nutrients (kg ha^{-1})		
		N	P	K
T_1	RDF (Normal sowing)	194.85	18.90	370.25
T_2	RDF+ opening of furrow at 30 DAS	198.28	19.21	375.70
T_3	RDF + opening of furrow at 45 DAS	200.76	19.46	371.44
T_4	75% RDN and 100% P and K through chemical fertilizer + 25% N through Green leaf manuring (Glyricidia) at the time of sowing and opening of furrow 30 DAS	218.68	22.64	386.89
T_5	75% RDN and 100% P and K through chemical fertilizer + 25% N through Green leaf manuring (Glyricidia) at the time of sowing and opening of furrow 45 DAS	214.92	21.58	384.61
T_6	75% of RDF + FYM @ 2.5 tonnes after opening of furrow 30 DAS	212.84	24.10	382.62
T_7	75% of RDF + FYM @ 2.5 tonnes after opening of furrow 45 DAS	211.36	23.21	383.83
	SE (m) $\pm$	5.68	1.16	3.56
	CD at 5%	17.50	3.59	10.98

through green leaf manuring (Glyricidia) at the time of sowing and opening of furrow 30 DAS which was succeeded by 75% RDN and 100% P and K through chemical fertilizer + 25% N through green leaf manuring (Glyricidia) at the time of sowing and opening of furrow 45 DAS. The available potassium with the application of 75% of RDF + FYM @ 2.5 tonnes and opening of furrow 30 DAS, and 75% of RDF + FYM @ 2.5 tonnes and opening of furrow 45 DAS was at par with each other. The lowest potassium (370.25 kg ha^{-1}) was recorded in treatment T_1 (370.25 kg ha^{-1}) RDF. The results of are in conformity with the findings of Hundekar *et al*. (1997), he has conducted field experiment in Karnataka with sorghum CVW-4-1 supplied with 5 t ha^{-1} sorghum straw, cotton stem, redgram (*Cajanas cajan*) stem, or green manures of subabul (*Leucaena leucocephala*), glyricidia, or sunhemp and 0,50 and 100% of recommend fertilizers. Organic carbon, available N, P, and K content of soil were increased by the organic manures, particularly when inorganic fertilizers was applied.

In-situ moisture conservation practices such as opening of furrow and incorporation of glyricidia resulted into improvement of uptake of nutrients by soybean, enhanced residual fertility of soils in respect of nitrogen, phosphorus and potassium. The yield of soybean was also significantly superior due to integrated practice of moisture conservation and application of green leaf manuring in soils. Therefore, under rain dependent agriculture and where consistent dry spells are occurred, the practice of opening of furrows after 30 DAS and incorporation of glyricidia leaves at the time of sowing significantly supported to maintain soil health and productivity of soybean

REFERENCES

Anonymous, 2016. FAO, at http//www.fao.org.

Chaturvedi, S. and A.S. Chandel, 2005. Influence of organic and inorganic fertilization on soil fertility and productivity of soybean (Glycine max). Indian J. Agron. **50** (4) : 311-313 .

Dubey, L. M. and P. Jain., 2015. Role of green manuring in organic farming Plant Archives pp. 23-26.

Gidda, V. R. and D. K. Morey, 1981. Effect of tillage practices and antitranspirant on relative water content , leaf water potential and yield of rainfed cotton (SRT-1). J. Maharashtra agric. Univ. **6**(3):219-220.

Guled, M.B., S.S. Gundlur, K. A. Hiremath, V.S. Surakod and S.R. Balnaoudar, 2002. Influence of different in-situ moisture conservation practices on soil properties and yield of sorghum-sunflower cropping system. Karnataka J. Agric. Sci. **15**(3): 514-517.

Halvankar, G.B., V. M. Raut, S.P. Taware, and U.P. Patil, 1992. Production component study in soybean. J. Maharashtra agric. Univ. **17**(3):199-200.

Hundekar, S. T., V. P. Badanur and P. A. Sarangnath, 1997. Influence of crop residues in conjunction with fertilizers on soil fertility, nutrient uptake and yield of sorghum. Karnataka J. Agri. Sci. **10**(10): 25-31.

Jackson, M.L., 1973. Soil Chemical Analysis. (Edn.2), Prentice Hall of India Pvt. Ltd., New Delhi.

Lal, R. 1974. Soil temperature, soil moisture and maize yield from mulch and unmulch. Indian J. Agric Sci. **39**(7): 745-747.

Mandal, B. K. and T. K. Ghosh, 1984. Effect of mulches on the growth and yield of sesame. Indian J. Agron. **29** (4):549-552.

Mandal, B.K.and V. K. Vamadevan, 1975. Effect of mulches growth yield of rabi crop in the Mahandi delta. Indian J. Agron. **20**(2):190-192.

Murthy, G. S. and M. O. Rao, 1969. Effect of mulching on growth and yield of tobacco crop in relation to soil temperature and moisture. Indian J. Agric Sci. **39** (7): 742 – 749.

Nawlakhe, S.M. and D.D. Mankar, 2009. Effect of integrated nutrient management on soil moisture content and soil physic-chemcial properties under long term experimentation site in cotton-greengram intercropping. J. Soils and Crops. **19**(2): 287 – 294.

Piper, C. S. 1966. Soil and plant Analysis, Hans. Pub. Bombay. Asian Ed. Pp. 368-374.

Shirale, S. T. and L. E. Khating, 2009. Effect of organic and inorganic nutrient on yield, nutrient uptake and balance in different cropping systems in Vertisols. Annals PI. Physiol., **23**(1) : 83-85.

Subbiah, B.V. and G.L. Asija , 1956. A rapid procedure for the estimation of available nitrogen in soils. Curr. Sci. **25**: 259-260.

Talati, P. K., 2004. Effect of inorganic and organic sources of nitrogen on summer soybean (Glycine max. (L.) Merril) under South Gujarat condition, M.Sc. (Agri) Thesis, submitted to N. A. U. Navsari.

Walkly, A. and I. A. Black, 1934. An examination of method for determining soil organic matter and proposal modification of the chromic acid titration method. Soil Science. **37**:29-38.

Watanable, F. S. and S. R. Olsen, 1965. Test of ascorbic acid method for determining phosphorus in water and sodium bicarbonate extracts of soils. Proc. Soil Sci. Am., **29**: 677- 678.

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