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Influence of moisture conservation practices and amendments on soil properties, yield and uptake of nutrients by Soybean in Inceptisols

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Abstract
An experiment was executed during the *kharif* 2016-17, to find out "Influence of moisture conservation practices and amendments on soil properties, yield and uptake of nutrients by 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 result indicated that the adoption of moisture conservation practices and use of soil amendments significantly influenced the physical and chemical properties of soil. Similarly, the fertility status of soil was also enhanced. Significantly highest yield and uptake of nutrients by soybean was registered in treatment T_6 where 75% of RDF + FYM @ 2.5 tones after opening of furrow at 30 DAS, while fertility status of soil were significantly enhanced in treatment T_4, where 75% RDN and 100% P and K through were applied through chemical fertilizer + 25% N through Green leaf manuring (Glyricidia) at the time of sowing and opening of furrow at 30 DAS. The integration of moisture conservation practices and soil amendments have greater significance in improving yield of soybean and 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 soil and water conservation measures 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 for achieving the desired moisture for sustainable 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 t 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) [5]. 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 grain yield (Murthi and Rao, 1969; Lal *et al.* 1974; and Mandal and Ghosh, 1984, Mandal and Vamadevan (1975) [10, 6, 8, 7]. The practice of opening furrow in between rows of crop is beneficial for improving drainage 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) [3]. 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.

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) [1]. 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 to identify the influence of moisture conservation practices and organic amendments on soil properties and yield of soybean.

Material and Methods

Site and Soil description

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 of experimental site was medium black with pH 7.60. The available nitrogen, phosphorous and potash were 185.37, 16.13, 363.84 kg ha^{-1} respectively. The JS-335 cultivar was sown with seed rate (75 kg ha^{-1}) and fertilizers (30:75:30 kg NPK ha^{-1}) were applied as recommended dose of fertilizers. 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 open after 30 and 45 days of sowing and 75% of RDF + FYM @ 2.5 tonnes was applied. The observation on fertility status of soil, yield and uptake were measured.

Results and Discussion

Residual Soil fertility

Chemical Properties

The highest (218.68 N kg ha^{-1} and 386.89 kg ha^{-1}) available nitrogen and potassium were recorded significantly more in treatment (T4) received 75% RDN through Green leaf manuring (Glyricidia) at the time of sowing along with 100 % P and K through chemical fertilizers and furrows were opened 30 days after sowing which was at par with treatment T5, T6, T7 while available phosphorus was increased in treatment T6 (24.10 kg ha^{-1}) where 75% RDF + 2.5 tonnes FYM was applied at the time of sowing and furrows were opened after 30 DAS, however treatment T4 and T6 (22.64 and 23.21 kg ha^{-1}) showed at par results. The lowest values (194.85, 18.90 and 370.25 kg ha^{-1} respectively) of available NP &K were registered in treatment T1 where recommended dose of fertilizers was applied alone. Similar trend of increase was also reported by Guled *et al*. (2002) [4].

Physical properties

The bulk density and mean weight diameter are the major indicators of physical properties of soil. The moisture conservation practices and use of organic amendments have significant correlation with physical properties. The bulk density under the present investigation was not changed significantly, but the mean weight diameter was enhanced significantly with moisture conservation practices and amendments. The highest mean weight diameter (0.43 mm) was reported in treatment T4 due to application of glyricidia at the time of sowing along with 75 % RDN and 100 % P and K given through chemical fertilizers and furrows were opened after 30 days of sowing. The lower value of mean weight diameter was noted in treatment T1 (0.41 mm), where recommended dose of fertilizer was given alone without any conservation practice. The mean weight diameter was slightly enhanced (0.42 mm) where75 % RDN and 100 % P and K was given through chemical fertilizers and opening of furrows after 45 days of sowing. The similar result also noted by Guled *et al.* (2002) [4], who has reported that application of organic manures and inorganic fertilizers resulted in increased mean weight diameter of soil.

Yield of Soybean

The yield of soybean was significantly influenced due to various treatments. Grain and straw yield of soybean was maximum (Grain 24.81 and straw 34.84 q ha^{-1}) in treatment T6 where 75 % RDF + FYM @ 2.5 tonnes was incorporated at the time of sowing and furrows were opened at 30 DAS followed by T4 (Grain 22.06 and 21.97 q ha^{-1}) where 75 % RDN and 100 % P and K through chemical fertilizer and 25 % N was applied through Green leaf manuring (Glyricidia) at the time of sowing and furrows were opened at 30 DAS. The lowest yield (Grain 17.95 and Straw 27.67 q ha^{-1}) of soybean were registered with treatment T1 where recommended dose of fertilizer was given alone without adopting any conservation practice. The integration of moisture conservation practices and amendments have significantly played vital role in making soil more friable, which ultimately helps in enhancement in rate of percolation and holding in water in subsoil. The availability of soil moisture in subsoil for long-time supported in formation of organic acids from incorporated organic amendments and also helps to solubilize added nutrients. Therefore, the nutrients are getting available for plant growth at proper time, which ultimately assisted in development of grains. More *et al*. (2015) [9]. Noticed that an application of organic and inorganic fertilizers resulted in increased in grain and straw yield of soybean.

Uptake of nutrients

The uptake of nutrients was studies under the present investigation. The integration of moisture conservation practices and organic amendments have greater significance in uptake pattern. The highest uptake of NPK (190.5, 22.65,

60.17 kg ha^{-1}) was registered with treatment T6 where 75 % RDN + 2.5 tonnes FYM were applied and furrows were opened at 30 DAS. Which was followed by treatment T4 (119.98, 20.06, 58.06 kg ha^{-1} N,P and K respectively) where 75 % RDN and 100% P and K through chemical fertilizer + 25 % N through Green leaf manuring (Glyricidia) incorporated at the time of sowing and furrow were opened at 30 DAS. The lowest uptake (128.93, 15.76, 46.89 kgha^{-1}) of NPK was found in treatment T1 where recommended dose of fertilizer was given. The increasing pattern of uptake is might be due to the addition of organic manures which help to increased uptake of nutrients. Similar finding were also reported by More *et al*. (2015) [9].

Conclusions

The integration of In-situ moisture conservation practices such as opening of furrow and incorporation of organic amendment like glyricidia resulted into improvement in physical properties and residual fertility of soil. Similarly, it has also helped in increasing grain and straw yield and uptake of nutrients by soybean. Considering the beneficial effect of moisture conservation practices and amendments in legumes, it is advocated to adopt the same in arid and semi-arid climatic conditions for obtaining sustainable crop production and soil helath.

Table 1: Available NPK (kg ha^{-1}) influenced by integration of moisture conservation practices and amendments

Treatments		N	P	K
		(kg ha-1)		
T1	RDF (Normal sowing)	194.85	18.90	370.25
T2	RDF+ opening of furrow at 30 DAS	198.28	19.21	375.70
T3	RDF + opening of furrow at 45 DAS	200.76	19.46	371.44
T4	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
T5	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
T6	75% of RDF + FYM @ 2.5 tonnes after opening of furrow 30 DAS	212.84	24.10	382.62
T7	75% of RDF + FYM @ 2.5 tonnes after opening of furrow 45 DAS	211.36	23.21	383.83
	SE (m) +	5.68	1.16	3.56
	CD at 5%	17.50	3.59	10.98

Table 2: Effect of moisture conservation practices and soil amendments on physical properties of soil

Treatments		BD (Mgm^{-3})	MWD (mm)
T_1	RDF (Normal sowing)	1.67	0.41
T_2	RDF+ opening of furrow at 30 DAS	1.67	0.42
T_3	RDF + opening of furrow at 45 DAS	1.66	0.42
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	1.64	0.43
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	1.65	0.42
T_6	75% of RDF + FYM @ 2.5 tonnes after opening of furrow 30 DAS	1.67	0.42
T_7	75% of RDF + FYM @ 2.5 tonnes after opening of furrow 45 DAS	1.66	0.41
	SE (m) $\pm$	NS	0.005
	CD at 5%	NS	0.016

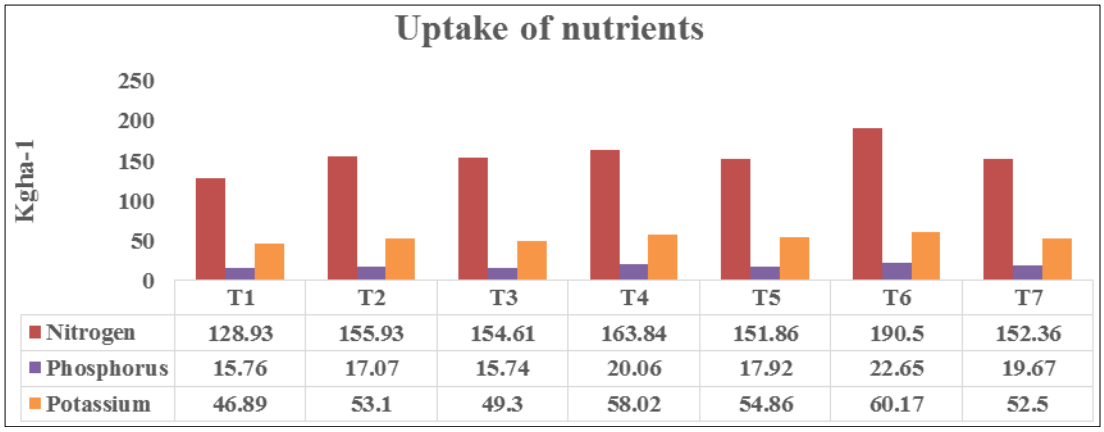

Fig 1: Effect of moisture conservation practices and soil amendments on uptake of nutrients

Table 3: Yield of Soybean (q ha^{-1}) influenced by moisture conservation practices and amendments

	Treatment	Grain	Straw
		(q ha^{-1})	
T_1	RDF (Normal sowing)	17.95	27.67
T_2	RDF+ opening of furrow at 30 DAS	21.42	30.41
T_3	RDF + opening of furrow at 45 DAS	19.70	29.48

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
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
T_6	75% of RDF + FYM @ 2.5 tonnes after opening of furrow 30 DAS	24.81	34.84
T_7	75% of RDF + FYM @ 2.5 tonnes after opening of furrow 45 DAS	21.14	29.52
	SE (m) $\pm$	0.91	1.27
	CD at 5%	2.81	3.92

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