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EFFECT OF CONSERVATION TILLAGE AND PIGEONPEA BASED INTERCROPPING SYSTEM ON YIELD AND SOIL HEALTH UNDER RAINFED CONDITION

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ABSTRACT

A field study was conducted at Agronomy farm, Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra) during *kharif* season of 2012-13.The experiment was laid out in factorial randomized block design with four replication consisting two tillage practices conventional tillage and minimum tillage and four levels of cropping system Sole pigeonpea, Pigeonpea + soybean (1:2), Pigeonpea + Sunhemp (1:2) and Pigeonpea+ soybean (1:5). Tillage did not show any significant effect on yield of pigeonpea/plant yield recorded higher in pigeonpea + soybean (1:2) whereas in case of soybean higher yield was recorded in pigeonpea + soybean (1:5). Organic carbon, SMBC, available NPK were found improved after harvesting of crop. Nitrogen, Phosphorus and Potash addition through biomass available for *in-situ* recycling and moisture content was found greater in minimum tillage as compared to conventional tillage as compared to conventional tillage.

Keywords:

Biomass, Conservation tillage, Intercropping, Pigeonpea, Soybean, Sunhemp

INTRODUCTION

Pigeonpea is one of the important tropical pulse crop of India and ranks seconds after chickpea in area and production. Food value of pigeonpea is protein (22.3%), fat (1.7%), minerals (3.5%), fiber (1.5%) and carbohydrates (57.6%). It is commonly known as red gram or arhar and grown in kharif as well as in rabi season. The area under pigeonpea crop in India is 3.5 million ha with the production of 2.48 million tones among the pulses in India (ESM, 2009).

The main concept of intercropping is to get increased total productivity per unit area and time, besides equitable and judicious utilization of land resources and farming inputs including labour, not to mention of insurance against failure of one or the other crops could be achieved. There are ample evidences to show that, the total yield can be increased with intercropping over sole cropping. One of the main reasons for higher yields in intercropping is that the component crops are able to use growth resources differently, so that when grown together, they complement each other and make better overall use of growth resources than grown separately (Willey, 1979). Intercropping of pulses and oilseed is one of the ways to increase pulse and oilseed production as it is more advantageous than the sole cropping of both pulses and oilseed (Lourduraj, *et al.,* 1998).Conventional tillage practices can result in significant losses of soil organic matter (SOM), inducing an increase in soil erosion and loss of soil structure (Dalal and Mayer, 1987). Conservation tillage is universally accepted to reduce soil erosion and facilitate water storage. It is especially important in semi-arid climate regions where the correct management of crop residues is essential to achieve sustainable yield (Du Preez *et al.,* 2001). Keeping these views in mind, an experiment was conducted to study the effect of conservation tillage and pigeonpea based intercropping system on per plant yield and soil health,

MATERIALS AND METHODS

A field experiment entitled “Effect of conservation tillage on growth, yield and quality of pigeon pea based intercropping system under rainfed” was conducted at Agronomy farm, Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (22^0 42' North latitude and 77^0 02’ East longitudes and at an altitude of 307.42 m above mean sea level) (Maharashtra) during *kharif* season of 2012-13 on medium deep black soil. The experiment was laid out in factorial randomized block design (FRBD) with four replication consisting two tillage practices conventional tillage and minimum tillage and four levels of cropping system sole pigeonpea, Pigeonpea + soybean (1:2), Pigeonpea + Sunhemp (1:2), Pigeonpea + soybean (1:5).

Pigeonpea variety PKV-Tara, soybean variety JS-355 and sunhemp local variety were sown. Sunhemp was cut and

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used as mulch in conventional tillage plots and used as in situ green manuring in minimum tillage plots. Weeds after hand weeding were used as mulch in all plots. Average rainfall was 591.3 mm during crop period. Sand (14.2%), silt (24.6%), and clay (62.2%) and textural class were recorded clay by Bouycous hydrometer method (piper, 1966). Available nitrogen (Subbiah and Asija, 1956), phosphorus (Olsen *et al.* 1954), potassium (Jackson, 1973), organic C (Walkley and Black, 1934), Soil pH and EC (Jackson, 1973) by ectrical conductivity meter.

RESULTS AND DISCUSSION

Yield

Tillage practices did not show any significant effect on seed yield per plant, pod straw yield per plant, biological yield/plant. In pigeonpea numerically higher value of yield was found in minimum tillage whereas in soybean it was observed in conventional tillage practices. Highest seed yield/plant and pod straw yield/plant were significantly highest with pigeonpea + sunhemp (1:2). Whereas higher soybean seed yield/plant (5.79 g) was recorded with pigeonpea + soybean (1:5). Similar result was found by Tewari*et al.* (1989). In soybean, higher pod straw (3.04 g) and stalk yield (109.3 g) were observed in pigeonpea + soybean (1:2). A higher value of stalk yield was found significantly in sole pigeonpea when compared with other treatment. The biological yield per plant (167.85 g) of pigeonpea was found maximum in sole pigeonpea and lowest with pigeonpea + soybean (1:5) i.e. 150 g/plant. It might be due to better uptake of natural resources.

Leaf litter and root biomass of crops and weeds

Tillage practices did not show any significant result on leaf litter, root biomass of pigeonpea, soybean and sunhemp, weed biomass. Cropping system showed significant effect on leaf litter, root biomass, weed biomass. Higher values of leaf litter (2681 kg) and total leaf biomass were found in pigeonpea + soybean (1:5) when compared with other treatments. In soy bean higher leaf litter were found in pigeonpea + soybean (1:5) (1488 kg) over treatment pigeonpea + soybean (1183 kg). It may be due to the higher population of pigeonpea.However, in case of total leaf biomass added was found higher (3686 kg) were found in conventional tillage over minimum tillage (3186 kg). Total leaf biomass (3082 kg) through pigeonpea + soybean (1:2) when compared with other treatments *viz.* sole pigeonpea (1992 kg), C_2 (2385), C_3 (1885 kg).

Average values of left over root biomass (kg/ha) were 547, 801 and 528 in pigeonpea, soybean and sunhemp. Left over root biomass of pigeonpea found maximum in conventional tillage 549 kg/ha. In soybean higher left over root biomass was in minimum tillage (851 kg/ha) over 751 kg in conventional tillage. In sunhemp maximum root biomasses were in conventional tillage (536 kg/ha). Cropping system shows significant effect on left over root biomass and higher root biomass in pigeonpea (739 kg) were found in sole pigeonpea as compared to other treatment *viz.* C_2 (533 kg), C_3 (620 kg) and C_4 (295 kg). In soybean higher left over root biomass was found in pigeonpea + soybean (1:5).Total root biomass and weed biomass were found highest in minimum tillage as compared to conventional tillage. The total root biomass was found maximum in pigeonpea + soybean (1:5) treatment as compared to other treatments. The highest weed biomass (1186 kg/ha) was found significantly in pigeonpea + soybean (1:5) over the treatment. The maximum space was available in between two pigeonpea rows where 5 rows of soybean planted and after harvest of soybean weed growth was observed and pigeonpea growth was slow up to 60 DAS due to those weeds were higher under pigeonpea sole.

Mean value of sunhemp biomass was 2650 kg/ha before green manuring was taken into account.In conventional tillage higher biomass available for recycling was observed in conventional tillage and lower in minimum tillage. The maximum biomass was available (6801 kg/ha) for in-situ recycling from pigeonpea + soybean (1:2) and lowest with sole pigeonpea (3885 kg/ha). The highest biomass was available due to addition of sunhemp green manuring and shed biomass in pigeonpea + sunhemp (1:2).

Electro-chemical properties and SMBC analysis

Soil reaction, electrical conductivity, organic C, soil microbial biomass C and available nitrogen, phosphorus and potassium were not influenced by tillage practices. Due to addition of leaf litter and root biomass of all three crops value of organic carbon and SMBC and available nitrogen, phosphorus and potash was higher than the initial value and these were also higher in minimum tillage. Average soil pH was 7.72 which were slightly lower than initial soil pH (7.82). Lowest soil pH was found in pigeonpea + sunhemp .It might due to addition of sunhemp as mulch. Kumar *et al.* (2008)and Rao and Janawade (2009) who reported that pH and EC reduced slightly with application of FYM, crop residues and green manure. EC was significantly higher in pigeonpea + sunhemp and lowest in pigeonpea + soybean (1:5). Similar result was found by Kumar *et al*. (2008). Due to green manuring of sunhemp crops recorded higher organic C content was found in pigeonpea + sunhemp (More and Hangarge, 2003; He *et al.*, 2009; Lal and Jacinthe, 2009).

Available NPK and Total NPK added through biomass available for *in-situ* recycling were significantly highest in pigeonpea + sunhemp and lowest in sole pigeonpea (Prasad *et al.*, 1997; Paslawar *et al.*, 2007).

Table 1 Influenced on crops yields by different cropping system and tillage practices

Treatment	Seed yield/plant (g)		Pod straw yield /plant(g)		Stalk yield/ plant (g)		Biological yield/plant (g)	
	Pigeonpea	Soybean	Pigeonpea	Soybean	Pigeonpea	Soybean	Pigeonpea	Soybean
Tillage Practices								
Conventional tillage	39.38	5.86	29.03	2.12	73.60	2.16	142.02	10.14
Minimum tillage	41.08	5.65	30.22	2.95	75.69	2.96	147.01	11.56
CD (*P*=0.05)	NS		NS		NS		NS	-
Cropping systems								
Pigeonpea	33.42	-	25.07	-	109.35	-	167.85	-
Pigeonpea + soybean(1:2)	40.96	5.71	31.48	3.04	65.02	3.02	137.47	11.78
Pigeonpea +sunhemp(1:2)	50.46	-	37.32	-	79.91	-	167.70	-
Pigeonpea + soybean(1:5)	36.08	5.79	24.65	2.03	43.31	2.09	105.04	9.92
CD (*P*=0.05)	4.49		4.71		10.74		12.52	

Table 2 Leaf litter, root biomass of weeds for *in-situ* recycling as influenced by tillage practices and cropping systems

Treatment	Leaf litter (g/m^2)		Leaf litter (kg/ha)		Leaf Biomass (kg/ha)	Left over Root biomass (kg/ha)			Root Biomass (kg/ha)	Weed Biomass (kg/ha)	*in-situ* recycling (kg/ha)
	Pigeonpea	Soybean	Pigeonpea	Soybean		Pigeonpea	Soybean	Sunhemp			
Tillage Practices											
Conventional	162	152	1626	1523	3149	549	751	536	1836	1067	6052
Minimum tillage	158	114	1588	1148	2736	544	851	520	1915	1211	5862
CD (*P*=0.05)	NS	-	NS	-		NS	-	-		36.2	
Cropping systems											
Pigeonpea	199		1992	-	1992	739		-	739	1154	3885
Pigeonpea+soybean (1:2)	186	118	1860	1183	3043	533	519	-	1052	1127	5221
Pigeonpea+sunhemp(1:2)	189		1893		1893	620		528	1148	1088	6779
Pigeonpea +soybean(1:5)	68	148	685	1488	2173	295	1083		1378	1186	4737
CD (*P*=0.05)	8.24	-	82.54	-		80.9	-	-		51.2	

Table 3 Effect of tillage practices and cropping system on electro-chemical properties and SMBC

Treatment	pH	EC (dS/m)	Organic C (g /kg)	SMBC (ug/g soil)		Available nutrient (kg/ha)			Total NPK available for *in-situ* recycling		
				90 DAS	180 DAS	N	P	K	N	P	K
Tillage Practices											
Conventional Tillage	7.75	0.279	6.37	253	170	241.4	18.2	337.7	67.71	30.46	**60.0**
Minimum Tillage	7.69	0.284	6.48	260	173	242.0	18.6	338.9	78.73	34.38	**78.7**
CD (*P*=0.05)	NS	NS	NS			NS	NS	NS	-	-	-
Cropping systems											
Pigeonpea	7.90	0.282	6.25	250	162	236.1	17.0	331.5	38.35	15.77	**34.9**
Pigeonpea + Soybean (1:2)	7.80	0.285	6.46	253	173	242.1	18.6	334.6	41.34	18.08	**37.4**
Pigeonpea + Sunhemp (1:2)	7.53	0.290	6.66	277	180	246.4	20.4	349.5	64.05	28.25	**65.5**
Pigeonpea + Soybean (1:5)	7.65	0.270	6.35	247	170	242.2	17.7	337.0	49.86	22.59	**39.8**
CD (*P*=0.05)	0.10	0.009	0.16			1.17	0.70	1.81	-	-	-
Initial status	**7.82**	**0.28**	**5.2**	**257**	**171**	**210**	**15.4**	**318**			

Table 4 Moisture (%) study as influenced by tillage practices and cropping systems

Treatment	At sowing	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	At harvest
Tillage Practices							
Conventional tillage	27.2	27.4	28.3	25.5	23.2	20.7	19.6
Minimum tillage	26.2	28.4	29.2	26.9	24.6	21.7	20.0
Cropping systems							
Pigeonpea	26.7	28.0	28.5	26.3	24.1	21.5	20.4
Pigeonpea +soybean(1:2)	26.6	27.1	27.8	25.7	23.4	20.9	19.2
Pigeonpea+ sunhemp(1:2)	26.8	28.7	29.8	27.7	25.3	22.5	21.0
C_4-pigeonpea + soybean (1:5)	26.7	27.7	28.9	25.1	22.8	19.2	18.6
GM	22.2	27.8	28.7	26.08	23.9	21.08	19.8

Moisture status

The moisture content was in higher in minimum tillage after 30 DAS. It might be due to *in-situ* green manuring of sunhemp. Moisture content was highest under pigeonpea + sunhemp during the complete growing period. In all treatment highest moisture content were recorded at 60 DAS. Similar result was noted by He *et al*. (2009).

CONCLUSION

In pigeonpea higher seed yield per plant yield was found in minimum tillage whereas in soybean higher seed yield/plant was found in conventional tillage. Leaf litter was maximum in pigeonpea + soybean (1:5) and minimum in pigeonpea + soybean (1:2). Higher total leaf litter biomass (4169 kg) were found in pigeonpea + soybean (1:5) and lowest in sole pigeonpea. Higher biomass available for *in-situ* recycling and moisture content was found in minimum tillage practices and in case of cropping system both were higher in pigeon pea + soybean (1:2). Higher pH, EC was found in conventional tillage whereas higher organic C, available NPK were found in minimum tillage.

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