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Effect of Different Methods of Tillage and Conservation Farming on Nutrient Uptake, Available Nutrient in Soil and Balance Sheet of Nutrient in Finger Millet [*Eleusine coracana* (L.) Gaertn.] Under Rainfed Conditions

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A B S T R A C T

Investigation was conducted during *kharif* season of 2016 at Instructional cum Research Farm, S.G. College of Agriculture and research station, Jagdalpur (C.G.). The soil of experimental field was sandy clay loam in texture and available N was low and, P and K were medium. The experiment was laid out in split plot design with two factors namely tillage practices and different conservation farming with three replications. The treatment consisted of three tillage practices *viz.* T1- Conventional tillage, T2 –Minimum tillage and T_3 – Summer ploughing and five conservation farming *viz.* C1-Opening conservation, C2-Intercropping with redgram, C3-Mulching, C4-Herbicide application, C5-Combination of all treatments (C_1+C_2+C_3+C_4). Two crops were taken as a taste crop *viz.* finger millet *cv* "GPU 28" and redgram *cv* "Rajeevlochan". The result revealed that summer plouging showed significantly highest available nitrogen and phosphorus but available potassium, pH, organic carbon and EC were recorded non-significant effect. Minimum tillage recorded significantly higher soil moisture and bulk density. N uptake and content recorded significantly highest in summer ploughing and P uptake and content recorded higher in minimum tillage but K uptake was not found significant due to tillage system in grain. In straw, N uptake was significantly higher in summer ploughing but N content was higher in conventional tillage whereas, P and K were found non-significant effect in tillage practices.

Keywords

Finger millet, Available nitrogen, Uptake and yield.

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Introduction

Finger millet [*Eleusine coracana* (L.) Gaertn.] is a stable food crop for millions of people in the semi-arid region of the world, particularly in Africa and India, and especially those who live by subsistence farming. This crop is cultivated in a wide geographical zone ranging from Senegal, Nigeria, across eastern and southern Africa, through the Middle East and into tropical Asia. Finger millet [*Eleusine coracana* (L.) Gaertn.] is among the most cultivated millets and belongs to the genus *Elelusine*, in the *Chloridoidae* subfamily. It is a native African crop which is also extremely important in South Asia (India and Nepal). The crop is adapted to a wide range of environments and can be grown in variety of soils with medium or low water holding capacity, but requires rainfall of at least 800 mm per annum (Thakur *et al.*, 2016). Millets are also unique due to their short growing season. They can develop from planted seeds to mature, ready to harvest plants in as little as 65 days. This is important in heavily populated areas. When properly stored, whole millets will keep for two or more years (Michaelraj and Shanmugam, 2013). Finger millet seeds can be stored for a very long time without any treatment (Gowda *et al.,* 2015). Millets are important food grains in the diets of a large section of population in India. The important small cereals among tribes of Bastar region after rice are kodo millet (*Paspalum scrobiculatum* L.) and finger millet [*Eleusine coracana* (L.) Gaertn.] (Verma and Mishra, 2010). The role of tillage in conserving soil moisture and its subsequent beneficial effect on crop productivity has long been recognized Adequate tillage operations controlled weeds and resulted in higher crop productivity, but caused more soil loss and were more capital intensive (Dogra *et al.*, 2002). Different tillage practices significantly influenced weed population. Irrespective of the weed species, conventional tillage significantly reduced the population of weeds compared to reduced tillage and minimum tillage. The inversion of soil by following conventional tillage resulted in deeper placement of weed seeds which could not emerge out, causing a significant reduction in the population of weeds (Vijaymahantesh *et al.,* 2013). Conservation tillage represents a broad spectrum of farming methods which are based on establishing crops in the previous crop's residue purposely left on the soil surface. The use of conservation tillage can play an important role in reducing soil erosion and improving soil quality (Uri *et al.,* 1999) and can be an attractive to conventional tillage for farmers because of it potential to minimum labour and fuel consumption and to lower total production cost (Uri, 2000). Use of minimum tillage and no-till system may provide sufficient soil water storage to produce economical fields of crops in intensive cropping system in the northern Great Plains. Incorporation of rice residues alters the soil environment, which is turn influences the microbial population in the soil and subsequent nutrient transformation. It is through this chain at events management of crop residues regulates the efficiency with which fertilizer, water and other reserve are used in cropping system. Crop residues (Straw mulch and plastic film mulch) should be part of integrated weed management in an agro-ecosystem which may selectivity give weed control through their physical presence on the soil surface and prevents nutrient loss, particularly nitrogen loss as volatilization and more availability of nitrogen increases vegetative growth (Bouman *et al.,* 2007 and Iqbal *et al.,* 2014).

Materials and Methods

Site description

The field experiment was carried out during *kharif* seasons of 2016-17 at Instructional cum Research Farm, S.G. College of Agriculture and research station, Jagdalpur (C.G.). Bastar (Chhattisgarh) is situated in between 19^{0}05'36.55" North latitude and 81^{0}57'34.69" East longitude with altitude ranging from 550-760m above mean sea level. During *khairf* 2016 a total of 1740.2 mm rainfall was received in 78 rainy days. There was no rainfall recorded at the end of the crop season. The maximum temperature varied from 31.7^{o}C in fourth week of June to 30.7^{o}C in fourth week of November, whereas, minimum temperature varies from 13.8^{o}C in first week of November to 13.1^{o}C in second week of December.

Soil physio-chemical properties

In order to determine the physical and chemical composition of experimental plot, soil samples were collected randomly from the experimental site up to 0-15 cm depth with the help of soil auger. A composite sample was drawn from mixed representative samples by dividing repeatedly till the amount of representative samples remain about 250 g and then it was used for analysis (Table 1).

Statistical analysis

The data obtained on various parameters were tabulated and subjected to statistical analysis. The difference of treatment was tested with F test, where F test shown their significance, the level of treatment were compared by critical difference at 5% level of probability. The skeleton of analysis of variance and formula used for various estimations are given by Gomez and Gomez (1984).

Results and Discussion

NPK content (%) and NPK uptake (kg ha^{-1}) in grain

Nitrogen content and uptake in grain

The data presented in Table 2 shows that the tillage and conservation farming significantly influenced the nitrogen content and uptake in finger millet. Treatment T_3 (Summer plouging) showed significantly highest nitrogen content and nitrogen uptake than the conventional and minimum tillage. In case of conservation farming, treatment C_5 recorded significantly highest nitrogen content and nitrogen uptake among all the conservation farming during experimentation. It was due to more dry matter production by crop and less nutrient depletion due to better management practices and subsequently more availability of nutrients to crop. These findings corroborate with those of Mukherjee (2008) and Gupta *et al.,* (2007). Graham *et al.,* (2002) measured significant increase in nitrogen content with increasing additions of crop residues. Similar result was obtained by Govaerts *et al.,* (2007).

Phosphorus content and uptake in grain

Phosphorus content and phosphorus uptake was significantly affected by different treatment (Table 2). The data reveals that the treatment T_2 (Minimum tillage) recorded significantly higher phosphorus content and phosphorus uptake than the T_1 (conventional tillage) and T_3 (Summer tillage). In conservation farming treatment failed to show significant impact on phosphorus content in finger millet. Whereas, uptake of phosphorus showed significant effect, treatment C_5 recorded significantly higher phosphorus content among all the conservation farming but it was on par with treatment C_4 (Herbicide application). Unger (1991) and Matowo *et al.,* (1999) found higher extractable phosphorus levels in minimum tillage compared to tilled soil in the top soil.

Potassium content and uptake in grain

Data shows that tillage and conservation farming unable to bring significant change in potassium content and uptake of finger millet during experimentation (Table 2).

Nitrogen content and uptake in straw

Data pertaining to nitrogen content and uptake by finger millet are presented in Table 3. Data shows that tillage methods had significant affect the nitrogen content and uptake by finger millet.

The nitrogen content and uptake was significantly highest in treatment T_1 (Conventional tillage) than the other tillage methods. Among the conservation farming nitrogen content and uptake had no significant differences in finger millet straw. The presence of organic residues on the surface induced more root growth and resulted in increased removal of nutrients by crops (Thiagalingam *et al.,* 1991).

Phosphorus content and uptake in straw

Data presented in Table 3 shows that tillage systems had no significant impact on P uptake and content in finger millet straw.

The phosphorus content and uptake was significantly higher in treatment C_1 (Opening conservation) but it was at par with C_2 (Intercropping with redgram) in phosphorus content and treatment C_3 (Mulching) in phosphorus uptake remaining treatments were found non-significant effect in finger millet straw. It might be due to the better soil environment, high seed rate, and better root growth conditioned by better moisture supply, favorable soil temperatures and less impedance to root proliferation which resulted in better translocation of absorbing nutrients from soil and its translocation to plant and seed translating into higher plant growth, grain and straw yields and ultimately increased the uptake of nutrient.

Potassium content and uptake in straw

The data on potassium content and uptake of finger millet straw are presented in Table 3. The data shows that there was no significant variation due to different tillage and conservation farming in finger millet straw. In general tillage method recorded higher phosphorus content and uptake in straw as compared to their respective treatment. In case of conservation farming, phosphorus content was numerically higher in treatment C_1 (Opening conservation) and higher uptake in C_5 (C1+C2+C3+C4) as compare to other conservation farming. Uptake of any nutrient is the function of its content and dry matter production by the crop. Higher nutrient content in the produce and higher biomass production of finger millet might be the pertinent reason for higher uptake of nutrients. These results also reported by Mehta *et al.,* (2005), Singh *et al.,* (2011) and Sujatha *et al.*, (2008).

Table.1 Initial physico-chemical properties of the soil (0-15 cm)

Properties	Values	Method of estimation
A. Physical: Particle size distribution		
Sand (%)	65.18	International pipette method (Black, 1965)
Silt (%)	10.81	
Clay (%)	23.90	
Textural class	Sandy clay loam	
Bulk density (Mg m^{-3})	1.18	Soil core method (Black, 1965)
B. Chemical		
pH (soil: water 1:2.5)	6.20	Glass electrode pH meter (Piper, 1967)
EC (dS m^{-1} at 25^{o}C)	0.10	Solubridge conductivity method, (Black,1965)
Organic carbon g kg^{-1}	0.50	Walkley and Black's rapid titration method (Black, 1965)
Available N (kg ha^{-1})	220.00	Alkaline permanganate method (Subbiah and Asija,1956)
Available P_2O_5 (kg ha^{-1})	12.99	By ascorbic acid method for - acidic soils (Bray, 1948).
Available K_2O (kg ha^{-1})	256.01	Flame photometer method as described by Muhr *et al.,* (1965).

Table.2 N, P and K contents and uptake after harvest of finger millet (Grain) as influenced by different tillage and conservation farming

Treatment	Nitrogen		Phosphorus		Potassium	
	Content (%)	Uptake (Kg ha^{-1})	Content (%)	Uptake (Kg ha^{-1})	Content (%)	Uptake (Kg ha^{-1})
			Tillage method			
T1	1.53	37.04	0.24	5.77	0.46	11.02
T2	1.53	40.17	0.29	7.55	0.42	11.04
T3	1.67	45.15	0.19	5.10	0.39	10.24
SEm±	0.02	0.92	0.01	0.28	0.04	0.89
CD at 0.05	0.09	3.72	0.04	1.12	NS	NS
			Conservation farming			
C1	1.42	32.62	0.21	4.89	0.42	9.54
C2	1.73	39.21	0.25	5.51	0.46	10.17
C3	1.43	36.33	0.21	5.19	0.42	10.51
C4	1.43	39.60	0.26	7.15	0.42	11.39
C5	1.87	56.17	0.27	7.95	0.42	12.22
SEm±	0.05	1.39	0.02	0.66	0.03	0.78
CD at 0.05	0.13	4.08	NS	1.92	NS	NS

T1: Conventional tillage, T2: Minimum tillage, T3: Summer plouging, C1: Open conservation, C2: Intercropping (finger millet + redgram), C3: Mulching, C4: Herbicide application, C5: C1+C2+C3+C4

Table.3 N, P and K contents and uptake after harvest of finger millet (Straw) as influenced by different tillage and conservation farming

Treatment	Nitrogen		Phosphorus		Potassium	
	Content (%)	**Uptake (Kg ha^{-1})**	**Content (%)**	**Uptake (Kg ha^{-1})**	**Content (%)**	**Uptake (Kg ha^{-1})**
			Tillage method			
T1	0.45	32.41	0.21	14.88	0.80	57.73
T2	0.36	22.95	0.23	14.73	0.74	49.91
T3	0.35	25.71	0.23	16.94	0.69	51.05
SEm±	0.008	1.34	0.007	0.61	0.09	7.01
CD at 0.05	0.034	5.39	NS	NS	NS	NS
			Conservation farming			
C1	0.43	31.01	0.26	18.54	0.78	55.98
C2	0.41	20.31	0.24	11.98	0.72	36.15
C3	0.35	27.19	0.23	17.27	0.72	54.02
C4	0.37	26.77	0.20	14.92	0.76	56.26
C5	0.37	29.84	0.18	14.87	0.75	62.07
SEm±	0.04	1.34	0.006	0.67	0.06	6.77
CD at 0.05	NS	NS	0.018	1.96	NS	NS

T1: Conventional tillage, T2: Minimum tillage, T3: Summer ploughing, C1: Open conservation, C2: Intercropping (finger millet + redgram), C3: Mulching, C4: Herbicide application, C5: C1+C2+C3+C4

Table.4 Soil physico-chemical properties of finger millet as influenced by different tillage and conservation farming

Treatment	N at harvest (kg ha^{-1})	P at harvest (kg ha^{-1})	K at harvest (kg ha^{-1})	Soil moisture % at harvest	Bulk density (g cm^{-3})	pH at harvest	OC % at harvest	EC at harvest
Tillage Methods								
T1	195.69	15.16	175.75	12.29	1.38	5.69	0.70	0.19
T2	193.18	12.54	172.22	17.16	1.45	5.72	0.74	0.19
T3	261.33	20.38	185.02	15.11	1.42	5.92	0.76	0.20
SEm±	5.99	1.26	6.53	0.71	0.01	0.06	0.04	0.01
CD at 0.05	24.16	5.09	NS	0.72	0.02	NS	NS	NS
Conservation farming								
C1	197.22	20.04	179.21	13.42	1.41	0.64	6.19	0.21
C2	240.43	15.68	175.90	12.05	1.41	0.68	6.13	0.21
C3	202.80	14.81	173.69	19.65	1.42	0.81	5.73	0.19
C4	201.0	13.94	166.70	12.93	1.41	0.67	5.81	0.19
C5	241.82	15.68	192.82	16.21	1.44	0.86	5.01	0.18
SEm±	9.05	2.67	6.53	0.72	0.01	0.04	0.09	0.01
CD at 0.05	26.58	NS	NS	2.12	NS	0.13	0.25	NS

T1: Conventional tillage, T2: Minimum tillage, T3: Summer ploughing, C1: Open conservation, C2: Intercropping (finger millet + redgram), C3: Mulching, C4: Herbicide application, C5: C1+C2+C3+C4

Table.5 Balance sheet of soil available Nitrogen (kg ha^{-1}) influenced by different tillage and conservation farming

Treatment	Initial available soil N (Kg ha^{-1})	Addition of N through fertilizers (Kg ha^{-1})	Total available N (Kg ha^{-1}) (2+3)	Removal of N by crop (Kg ha^{-1})	Expected balance of available N (Kg ha^{-1}) (4-5)	Actual balance of available N (Kg ha^{-1})	Calculated gain of available N (Kg ha^{-1}) (7-6)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			Tillage Methods				
T1	220.00	60.00	280.00	69.43	210.57	195.69	-39.41
T2	220.00	60.00	280.00	63.11	216.88	193.18	-35.42
T3	220.00	60.00	280.00	70.85	209.14	261.33	+53.19
SEm±	-	-	-	2.05	2.05	5.99	-
CD at 0.05	-	-	-	NS	NS	24.16	-
			Conservation farming				
C1	220.00	60.00	280.00	63.63	216.37	197.22	-48.47
C2	220.00	60.00	280.00	59.50	220.49	240.43	+32.73
C3	220.00	60.00	280.00	63.51	216.48	202.80	-34.29
C4	220.00	60.00	280.00	66.34	213.63	201.40	-43.24
C5	220.00	60.00	280.00	86.34	193.99	241.82	+54.64
SEm±	-	-	-	2.66	2.66	9.05	-
CD at 0.05	-	-	-	7.81	7.80	26.58	-

T1: Conventional tillage, T2: Minimum tillage, T3: Summer plouging, C1: Open conservation, C2: Intercropping (finger millet + redgram), C3: Mulching, C4: Herbicide application, C5: C1+C2+C3+C4

Table.6 Balance sheet of soil available Phosphorus (kg ha^{-1}) influenced by different tillage and conservation farming

Treatment	Initial available soil P (Kg ha^{-1})	Addition of P through fertilizers (Kg ha^{-1})	Total available P (Kg ha^{-1}) (2+3)	Removal of P by crop (Kg ha^{-1})	Expected balance of available P (Kg ha^{-1}) (4-5)	Actual balance of available P (Kg ha^{-1})	Calculated grain of available P (Kg ha^{-1}) (7-6)
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
			Tillage Methods				
T1	12.99	40.00	52.99	20.65	71.75	15.16	-56.60
T2	12.99	40.00	52.99	22.28	70.13	12.54	-57.58
T3	12.99	40.00	52.99	22.04	70.36	20.38	-49.98
SEm±	-	-	-	0.44	0.44	1.26	-
CD at 0.05	-	-	-	NS	NS	5.09	-
			Conservation farming				
C1	12.99	40.00	52.99	23.44	68.96	20.04	-48.93
C2	12.99	40.00	52.99	17.49	74.91	15.68	-59.23
C3	12.99	40.00	52.99	22.46	69.94	14.81	-55.13
C4	12.99	40.00	52.99	22.06	70.34	13.94	-56.40
C5	12.99	40.00	52.99	22.82	69.58	15.68	-53.90
SEm±	-	-	-	0.76	0.76	2.67	-
CD at 0.05	-	-	-	2.23	2.23	NS	-

T1: Conventional tillage, T2: Minimum tillage, T3: Summer ploughing, C1: Open conservation, C2: Intercropping (finger millet + redgram), C3: Mulching, C4: Herbicide application, C5: C1+C2+C3+C4

Table.7 Balance sheet of soil available Potassium (kg ha^{-1}) influenced by different tillage and conservation farming

Treatment	Initial available soil K (Kg ha^{-1})	Addition of K through fertilizers (Kg ha^{-1})	Total available K (Kg ha^{-1}) (2+3)	Removal of K by crop (Kg ha^{-1})	Expected balance of available K (Kg ha^{-1}) (4-5)	Actual balance of available K (Kg ha^{-1})	Calculated grain of available K (Kg ha^{-1}) (7-6)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			Tillage Methods				
T1	346.92	30.00	376.92	68.75	308.94	175.75	-132.43
T2	346.92	30.00	376.92	60.95	315.67	172.22	-143.72
T3	346.92	30.00	376.92	61.29	315.63	185.02	-130.61
SEm±	-	-	-	7.61	7.61	6.53	-
CD at 0.05	-	-	-	NS	NS	NS	-
			Conservation farming				
C1	346.92	30.00	376.92	65.52	311.40	179.21	-132.14
C2	346.92	30.00	376.92	46.32	330.60	175.90	-154.71
C3	346.92	30.00	376.92	64.53	312.39	173.69	-138.71
C4	346.92	30.00	376.92	67.66	309.26	166.70	-142.57
C5	346.92	30.00	376.92	74.29	302.63	192.82	-109.80
SEm±	-	-	-	7.08	7.08	9.48	-
CD at 0.05	-	-	-	NS	NS	NS	-

T1: Conventional tillage, T2: Minimum tillage, T3: Summer ploughing, C1: Open conservation, C2: Intercropping (finger millet redgram), C3: Mulching, C4: Herbicide application, C5: C1+C2+C3+C4

pH, OC and EC

pH, OC and EC in soil of finger millet plot as influenced by different tillage and conservation farmings are presented in Table 4. The data revealed that in tillage system pH, OC and EC could not produce significantly impact in finger millet field. Kumar and Yadav (2005) reported that value of organic carbon, electrical conductivity and soil pH were either equal or slightly higher than their initial values due to tillage treatment. Jacobs *et al.*, (2009) found that minimum tillage, compared with conventional tillage, did not only improve aggregates stability but also increased the concentration in the upper 5-8 cm soil depth In case of conservation farming, pH, OC and EC recorded significantly effect, pH recorded significantly higher in treatment C_1 (Opening conservation) which was at par with treatment C_2 (Intercropping with redgram) and lowest pH was recorded in treatment C_5. Whereas, in organic carbon in conservation farming, treatment C_3 recorded significantly higher organic carbon among all the treatments. EC could not produce significant impact in soil of finger millet field during experimentation.

The findings are in agreement with those of Madari *et al.*, (2005) and Riley *et al.*, (2005) who reported that conservation tillage with residue cover had higher total organic carbon in soil aggregates than traditional tillage. Osunbitan *et al.*, (2005) examined the effects of tillage on bulk density, hydraulic conductivity and strength of a loam sand soil. They found that the bulk density and penetration resistance of surface soil decreased with increase in the intensity of soil loosening by tillage operation. Residue retention and direct seeding have a major influence on improving water infiltration, organic matter content and fertility of a soil (Wall, 1999). Mulch cover shields the soil from solar radiation thereby reducing evaporation from the soil. Soil biota increase under mulched soil environment thereby improving nutrient cycling and organic matter build up over a period of several years (Holland, 2004).

Available NPK in finger millet

The data on available N, P and K in soil of finger millet field as influenced by different tillage and conservation farmings are presented in Table 4. The findings revealed that treatment T_3 (Summer plouging) recorded significantly higher available N and P but K could not give significant influence in tillage methods in finger millet field. As regard to conservation farming treatment C_5 recorded significantly highest available N which was at par with in treatment C_2 (Intercropping with redgram). Available P and available K could not give significantly influence in conservation farming treatment in finger millet. Varalakshmi (2005) observed that the higher available phosphorus might be due to the release of organic acids during microbial decomposition of organic matter which helped in the solubility of native phosphates thus increasing available phosphorus. The applied organic matter may have led to formation of coating on the sesquioxide clay minerals, because of which the phosphate fixing capacity of soil is reduced in manure treated plots compared to inorganic fertilizer alone.

Roldan *et al.*, (2005) observed that the accumulation of P at the top soil in zero tillage and minimum tillage can be explained by the limited downward movement of particle bound P in no-till and minimum-till soils and the upward movement of nutrients from deeper layers through uptake by roots. Available potassium increased significantly in the toplayer of shallow tilled soil, but not in the 10-20 cm layer compared with ploughed soil (Comia *et al.*, 1994).

Balance sheet of available nitrogen (Kg ha^{-1})

The data on balance sheet of available N of finger millet field as influenced by different tillage and conservation farming presented in Table 5, the findings revealed that actual balance of available nitrogen, was significantly highest in treatment T_2 (Minimum tillage) than the other tillage treatments. Removal of nitrogen by crop, expected balance of available

N and calculated gain of available N was found non-significant effect due to tillage treatments. Conservation farming brought significantly, where treatment C_5 (C1+C2+C3+C4) recorded significantly higher removal of N by crop and actual balance of available N but actual balance of available N was at par with C_2 (Intercropping with redgram). Expected balance of available N was significantly higher in treatment C_2 (Intercropping with redgram) which was at par with C_3 (Mulching), C_1 (Opening conservation) and C_4 (Herbicide application) in conservation farming.

Balance sheet of available phosphorus (Kg ha^{-1})

Data presented in Table 6 reveals that removal of P by crop and expected balance of available P in different tillage and actual balance of available P and calculated gain available P in conservation farming show non-significant differences. Actual balance of available P was significantly highest in treatment T_3 (Summer plouging) whereas, treatment T_1 (Conventional tillage) recorded significantly higher calculated gain available P in finger millet field which was at par with treatment T_2 (Minimum tillage) in tillage methods. In conservation farmings, C_1 (Opening conservation) recorded significantly higher removal of P by crop which was on par with C_5 (combination of all treatment), C_3 (Mulching) and C_4 (Herbicide application) and lowest removal of P by crop was recorded in conservation farming C_2 (Intercropping with redgram). Expected balance of available P recorded significantly highest C_2 (Intercropping with redgram) among all the conservation farming treatments.

Balance sheet of available potassium (Kg ha^{-1})

The data on balance sheet of soil available K in finger millet field as influenced by different tillage and conservation farming are given in Table 7 and the finding revealed that removal of K by crop expected balance of available K, actual balance of available K and calculated gain of available K remained unaffected due to tillage and conservation farming.

Summer plouging showed significantly highest available nitrogen, phosphorus but available potassium, pH and EC was recorded non-significant. Tillage recorded significantly higher soil moisture over conventional tillage, but bulk density was significantly highest in minimum tillage. Tillage system recorded significant effect N uptake and content in summer plouging and P uptake and content in minimum tillage but K uptake was not found significant effect due to tillage system in grain. In straw N uptake was significantly affected in summer plouging but N content was higher in conventional tillage, P and K was found non-significant in tillage practices.

Available N was significantly higher in combination of all treatments but available P, K, bulk density and EC recorded non-significantly. In conservation farming system mulching recorded significantly higher soil moisture and organic carbon but higher pH, N uptake and content value was recorded significantly higher intercropping with finger millet + redgram, P uptake significantly higher in combination of all treatments. P content, K uptake and K content observed non-significantly effect during experimentation in grain. In case of conservation farming system P uptake and content was significant higher in mulch and opening conservation.

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