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RESEARCH ARTICLE

Tillage and nutrient management as quality improver in fodder oat under oat-paddy cropping system.

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Abstract

A field experiment was conducted at forage field situated at College of Veterinary Science and Animal Husbandry, campus of BAU Ranchi (Jharkhand) to study the effect of tillage and nutrient management on oat-paddy cropping system during 2011 and 2012. It is clear from the graph that the content of N (at second cut) and B (at both the cuts) in forage oat were maximum under conventional tillage. Ca and Fe content were higher under zero tillage. Contents of P and K under conventional tillage were significantly higher compared to minimal and zero tillage. Uptake of N, P, K and Fe by forage oat was significantly higher under conventional tillage as compared to minimal tillage and zero tillage. Crude protein and crude fiber recorded under zero tillage at both the cuts remained at par with conventional tillage but significantly superior to minimal tillage. Further, crude fat and NFE contents under zero tillage were significantly higher compared to minimal as well as conventional tillage. With regards to nutrient levels, 125 % RDF recorded maximum content and uptake of all the nutrients. Nutrient levels negatively responded on crude fat and NFE while, crude protein and crude fiber were positively correlated

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Introduction:-

The accelerated population pressure on earth has pose a major challenge before the farmers as well as agricultural scientist to produce more and more food and forage from limited physical and shrinking land resources. Indian soils with big variances suffer different fertility standing which is guided by change in sowing to harvesting activity. Jharkhand is a state with limited irrigation facility and mono cropping with *Kharif* crops *i.e.* rice-fallow is prevalent cropping system. Due to heavy pressure on soil and wrong method of tillage operation and injudicious use of fertilizer, deteriorating the soil health and further resulted into deprived soil fertility. Jharkhand soils are generally acidic in nature which causes fixation of mainly P and Ca leading to poor availability of major and micro nutrients (Singh and Sarkar, 1998). Farmers are generally growing fodder in upland, unfertile and under energy stress condition which resulted into inferior quality of herbage produced that causes, malnutrition in animal. Forage oat is considered as an excellent combination of nutrient and quality fiber which is suited to every type of animal. Oat, single as well as multi-cut in nature is also highly responsive to fertilizers having good source of macro (N, P, K, Ca, Mg and S) as well as micro (Fe, Mn, Cu, B, Co, Cl, Na etc.) elements (Garg *et al.*, 2005 and Singh *et al.*, 2009). Uses of bio-fertilizers are generally advocated under prevailing situation through improving N and P status of soil. Among the different sources of bio-fertilizer, phosphate solublizing bacteria (PSB) and *Azotobacter* can be applied along with lower levels of nutrient as alternate source to meet the high requirement of nutrient in multi-cut forage oat. *Azotobacter*, free living nitrogen fixing bacterium lives in association with plant roots and fixes atmospheric nitrogen in readily available form to plants. *Azotobacter* is also high respiring organism and hence works well in the soils having sufficient organic matter. The use of PSB as inoculants simultaneously increases P uptake by the plant and crop yield.

Materials And Methods:-

A trial was carried out during *Rabi* and *Kharif* season of 2011 and 2012 at the forage field situated at College of Veterinary Science and Animal Husbandry, campus Kanke under Birsa Agricultural University, Ranchi. The soil of field was sandy loam in texture having sand (56.8%, silt (28.0%), clay (15.2%) and water holding capacity (38.68 %) with pH (6.2). The initial organic carbon (3.8 g/kg) with available nitrogen (232 kg/ha), available phosphorus (23.25 kg/ha) and available potassium (156.41 kg /ha). Further, available Ca (151.4 mg/kg), available Fe (55.0 mg/ kg), available Zn (1.13 mg/ kg) available B (0.63 mg/ kg), while in terms of biological character the population of *Azotobacter* (3.2×10^4 cells/ g soil) *Actinomycetes* (12×10^6 cells/ g soil) and CO₂ evolution (107 mg /kg soil/ day) was present before the experimentation. The experiment was laid out in Split- plot Design (SPD) with three tillage management, Zero tillage, Minimal tillage and Conventional tillage under main plot and four nutrient management, 125 % RDF, 100 % RDF, 75 % RDF and 75% RDF+ Bio-fertilizer (PSB+ *Azotobacter*) in sub plot treatment and replicated thrice which were applied in oat. The fodder oat (Cultivar : Kent) was sown in the second week of November, keeping row to row distance 25 cm with recommended seed rate 100 kg/ha in 5 m X 4 m plot area under medium land condition. Fertilizers were applied at the time of sowing through urea, DAP and MOP as basal application. Bio-fertilizer was applied as seed inoculating material in the form of PSB @ 500 g/ha and *Azotobacter* @ 500 g/ha and further top dressing were carried through urea. Paddy was transplanted during *Kharif* after harvest of oat in the same laid out field at same levels of tillage and uniform fertilizer dose @100:50:25, NPK kg/ha (just 25% less than RDF). Paddy was grown at normal agronomical practice. The data on dry fodder yield and nutrient content in fodder oat at every cut taken both the years, further on pooling the data recorded were properly analyzed in standard format of Split-plot Design and presented below in tabular and graphical form for better clarity.

Result And Discussion:-

Nutrient content:-

The content of different nutrients *viz.* N, P, K, Ca, Fe, Zn, and B in forage oat were determined at each cut in both the years, further cut wise pooled of two years was obtained and presented here in graphical form. Both tillage and nutrient management influenced significantly the nutrient content of forage oat like N, P, K, Ca, Fe and B while the Zn content was neither affected by tillage management nor by nutrient management (Figs. 1 & 2). Different nutrient contents *viz.* N, P and K in forage oat under conventional tillage were significantly higher over minimal tillage and zero tillage at both the cuts except N content at second cut where zero tillage was at par with conventional tillage. Calcium content under zero tillage and conventional tillage were at par at first cut while at second cut zero tillage was significantly superior to conventional as well as minimal tillage while iron under zero tillage was at par with conventional tillage and superior to minimal tillage. Boron content at both cuts under conventional and zero tillage was at par to each other and which were significantly superior to minimal tillage. Content of different nutrients were higher at second cut over first cut except that of nitrogen. Content of N, P, K, Ca and B were higher under conventional tillage followed by zero tillage while Fe content was higher under zero tillage which might be combined result of availability of nutrients and activity of roots, which varied differently under different tillage practices (Veer *et al.*, 2010). The higher mineralization rate was also responsible for more availability of nutrients which result in higher uptake of nutrients in conventional tillage. Małecka and Blecharczyk (2008) found in spring barley that nitrogen intake of grain was significantly lower in zero tillage than in conventional tillage. Nitrogen content in oat at second cut was always lower than at first cut under different tillage and nutrient management condition. This was due to better root development and more nitrogen absorption which converted into significantly higher leafy portion up to first cut under conventional tillage. The decrease in nitrogen content with the advancement of age was also due to dilution with increased structural carbohydrates content (especially fiber) of ageing crops. Further, uptake of different nutrients was also influenced by tillage management and it was maximum under conventional tillage followed by zero tillage and minimal tillage.

On other hand, nutrient management also significantly affected the nutrient content in forage oat at both the cuts up to 125 % RDF. Besides, content of N, P, K, Fe and B at 100 % RDF were at par with 75 % RDF + Bio-fertilizer whereas, Ca content at 125 % RDF was at par with 75 % RDF + Bio-fertilizer. Interaction of tillage and nutrient management has no significant affect on contents of forage oat *viz.* N, P, K, Ca, Fe, Zn and B.

Nutrient uptake:-

Tillage and nutrient management significantly influenced the nutrient uptake *viz.* N, P, K and Fe content in forage oat while Ca, Zn and B uptake were affected by nutrient management only. Uptake of N (122.56 kg/ ha), P (33.44 kg /ha), K (114.18 kg/ ha), Fe (0.712 kg/ ha) and B (0.178 kg/ ha) by forage oat were significantly higher under conventional tillage as compared to minimal tillage and zero tillage. In case of nutrient management higher uptake of the different nutrients like N (130.05 kg/ ha), P (35.65 kg/ ha), K (119.22 kg/ ha), Fe (0.712 kg/ ha), Ca (38.13 kg/ ha), Zn (0.282 kg/ ha) and B (0.185 kg/ ha) were recorded fewer than 125 % RDF compared to the rest of the nutrient doses.

Further, 100 % RDF was significantly superior over 75 % RDF + Bio-fertilizer except B and K uptake. Minimum uptakes of these nutrients were recorded at 75 % RDF (Table1). Uptake of nutrient by oat as the result of its content and dry fodder yield was maximum under conventional tillage. Singh (1992) reported that nitrogen content in plants continuously decreased with age of the crop and increased significantly with increase in nitrogen levels at all the stages. This was mainly due to more nitrogen absorption, higher LAI and higher leaf stem ratio. Pisal *et al.* (1993) observed that increased doses of nitrogen from 0 to 120 kg ha⁻¹ increased the nitrogen availability and its uptake. Kirkham and Wilkins (1994) observed consistently higher concentration of nitrogen in plants harvested from plots assigned to the highest dose of nitrogen. This was due to better root development which resulted higher dry matter production and improved nutrient content at higher levels of nutrient. Interactions affect of tillage and nutrient management was not significant on uptake of nutrients.

Crude protein, Crude fiber, Fat, and Nitrogen free extract:-

Crude protein and crude fiber under conventional and zero tillage were at par to each other however, higher crude protein (10.26 % at first cut) and crude fiber (27.98 and 29.56 %) under conventional tillage and higher NFE (46.89 and 48.41 %) under zero tillage at both the cuts respectively were recorded. NFE under conventional and minimal tillage were at par to each other. Crude fat under zero tillage was significantly superior over conventional as well as minimal tillage and which were at par to each other. This was due to better root development and more nitrogen absorption which converted into significantly higher leaf: stem ratio up to first cut. The decrease in crude protein and increase in fat and fiber with age were also due to increased structural carbohydrates content with the crop age. Verma and Srivastav (1988) also reported the similar results. Besides, other parameters like nitrogen free extract was higher at second cut over first cut i.e. NFE increased with advancement of crop age. This might be due to fact that after first cut, established root system of crop started functioning in faster way for re-growth and absorbed more nutrients resulted in higher dry matter production which increased in fiber content and roughness with less contribution of leafy portion and finally resulted in less protein content and high in fiber and fat content

Increase in levels of RDF crude protein and crude fiber significantly increased while nitrogen free extract significantly decreased with increase in levels of nutrient. Quality parameters mentioned above except crude fat at 100 % RDF were at par with 75 % RDF + Bio-fertilizer (Table 2). According to Verma and Singh (1988) higher crude protein at higher levels of nitrogen was due to more availability of nitrogen and thereby its uptake by crop. Similar reasons were also reported by Anay and Agrawal (2010) and they also reported that nitrogen content in plant tissue continuously decreased with the age of the crop and increased significantly with the increase in nutrient levels at first cut. The result confirmed with the finding of Tripathi (1994), Deorari (2002) and Pederson *et al.* (2002) who were also reported that higher absorption of nitrogen through the plants increased the mesistematic activities of plants. Crude fat, fiber and NFE decreased with increased level of nutrient. During second cutting, proportion of leaf and stem decreased and fodder became harder than that of first cut and accordingly increased the crude fat, fiber and NFE. Correlation exist among different quality parameter signified the result (Figs. 5.6 and 5.7). Similar results for quality parameter in forage oat were also reported by (Aklilu, 2005).

Table 1:- Effect of tillage and nutrient management on nutrient uptake in forage oat under oat –rice cropping (pooled)

Treatments	Nutrient uptake (kg/ ha)						
	N	P	K	Ca	Fe	Zn	B
Tillage Management (T)							
Zero tillage	106.98	25.29	94.51	33.41	0.631	0.23	0.156
Minimal tillage	99.64	25.28	91.13	30.46	0.553	0.21	0.134
Conventional tillage	122.56	33.44	114.18	35.10	0.680	0.25	0.178
S.Em ±	1.46	0.72	1.61	1.32	0.09	0.21	0.11
CD at 5%	5.72	2.82	6.31	NS	0.32	NS	NS
Nutrient Management (N)							
125% RDF	130.05	35.65	119.22	38.13	0.712	0.28	0.185
100% RDF	112.03	28.10	101.57	33.78	0.619	0.24	0.158
75% RDF	92.69	21.06	80.85	28.78	0.546	0.21	0.131
75% RDF +Bio-fertilizers	104.14	27.23	98.12	31.28	0.603	0.21	0.150
S.Em ±	2.55	0.78	1.46	0.75	0.015	0.004	0.003
CD at 5%	7.58	2.32	4.33	2.23	0.18	0.01	0.008
CV %	6.97	8.35	7.38	6.81	7.44	5.66	5.76
Interaction (TXN)	NS	NS	NS	NS	NS	NS	NS

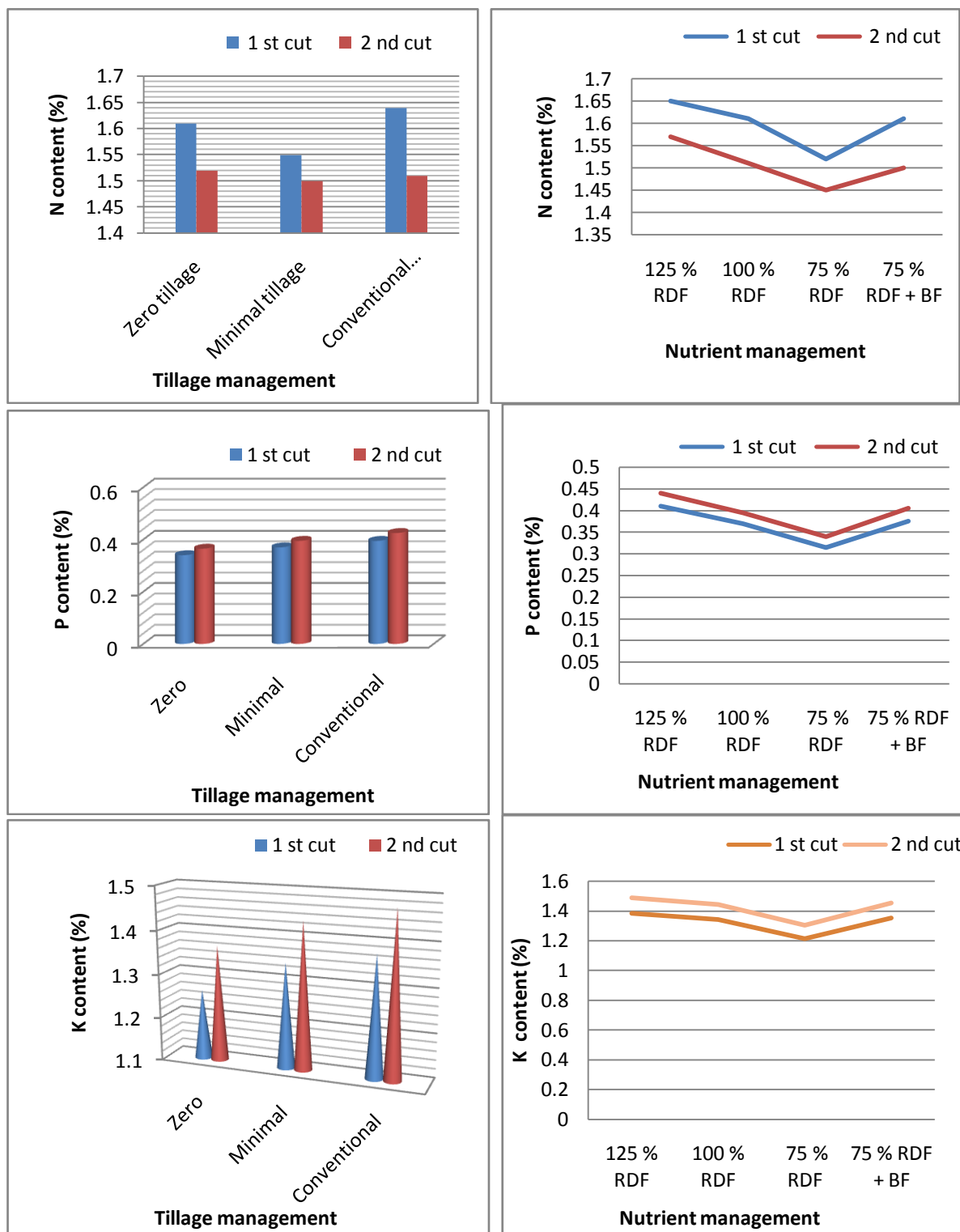
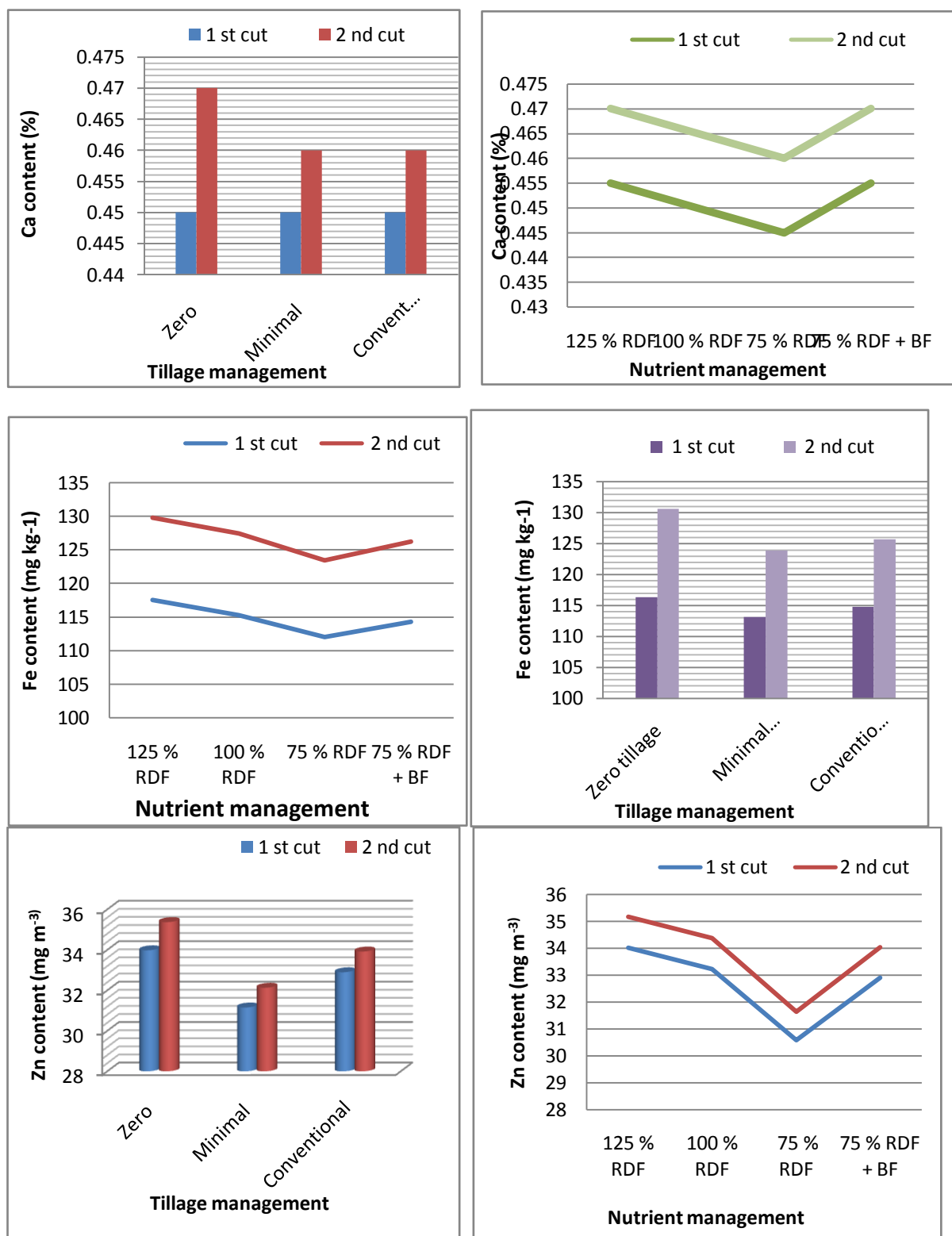
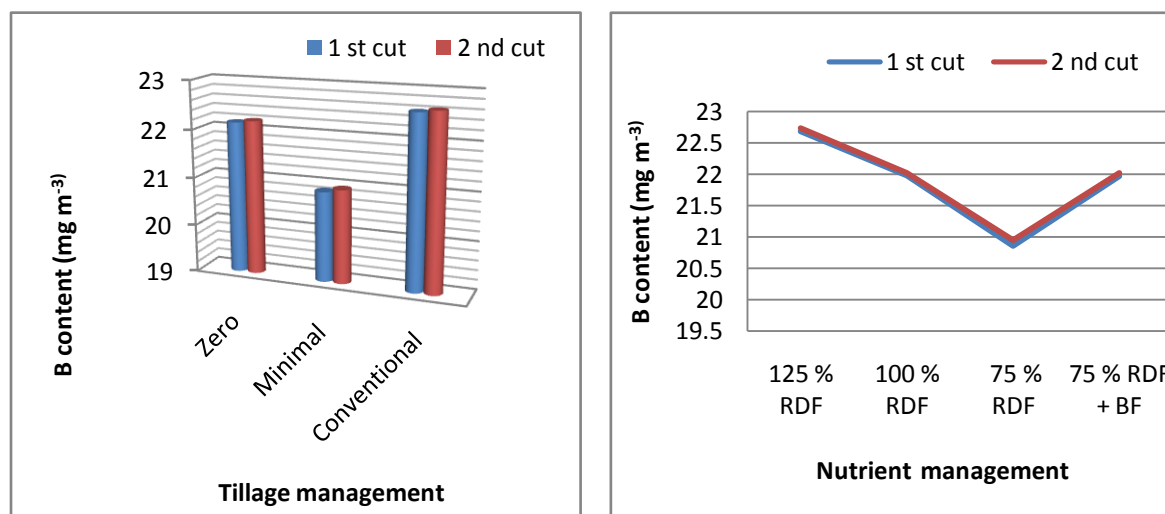


Fig. 1:- Effect of tillage and nutrient management on nutrient content (N, P and K) in forage oat under oat-rice cropping system.



Figs. 2:- Effect of tillage and nutrient management on nutrient content (Ca, Fe and Zn) in forage oat under oat-rice cropping system.



Figs. 3:- Effect of tillage and nutrient management on boron content in forage oat under oat -rice cropping system.

Table 2:- Effect of tillage and nutrient management on quality parameters of forage oat under oat –paddy cropping system (pooled).

Treatments	Crude protein (%)		Crude fat (%)		Crude fiber (%)		Nitrogen free extracts (%)	
	1 st cut	2 nd cut	1 st cut	2 nd cut	1 st cut	2 nd cut	1 st cut	2 nd cut
Tillage Management (T)								
Zero tillage	10.09	9.54	1.01	1.02	26.10	27.68	46.89	48.41
Minimal tillage	9.69	9.37	0.90	0.92	24.47	26.05	44.97	46.47
Conventional tillage	10.26	9.44	0.91	0.92	27.98	29.56	44.79	46.31
S.Em ±	0.07	0.04	0.01	0.01	0.48	0.49	0.09	0.09
CD at 5%	0.27	0.15	0.04	0.04	1.92	1.92	0.35	0.35
Nutrient Management (N)								
125% RDF	10.34	9.86	0.92	0.94	26.64	28.21	44.94	46.46
100% RDF	10.08	9.44	0.94	0.96	26.31	27.89	45.38	46.90
75% RDF	9.54	9.10	0.96	0.97	25.80	27.37	46.27	47.80
75% RDF + Bio-fertilizer	10.08	9.39	0.94	0.95	26.00	27.57	45.59	47.13
S.Em ±	0.15	0.13	0.006	0.006	0.05	0.05	0.11	0.12
CD at 5%	0.44	0.38	0.02	0.02	0.15	0.15	0.34	0.35
CV %	4.49	4.13	1.92	1.90	0.60	0.56	0.76	0.74
Interaction (TXN)	NS	NS	NS	NS	NS	NS	NS	NS

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