International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(6): 2795-2798

Received: 03-09-2020
Accepted: 12-10-2020

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Effect of resource conservation practices on yield attributes and yield in maize based cropping system

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DOI: https://doi.org/10.22271/chemi.2020.v8.i6an.11204

Abstract
The present investigation was carried out during *Kharif* and *Rabi* seasons of 2017-18 and 2018-19 at Students Instructional Farm (SIF) of C.S. Azad. University of Agriculture & Technology, Kanpur, entitled "Effect of resource conservation practices on yield attributes and yield in maize based cropping system" The treatments were comprises of three cropping systems (Maize-Wheat, Maize-Field Pea and Maize-Mustard), two moisture conservation practices (Mulching and No mulching) and three nutrient management treatments (100% RDF, 85% RDF+2.5 tonne/ha FYM and 70% RDF+5.0 tonne/ha FYM application of FYM only in *kharif* season). The field experiment was laid out in Split Plot Design with three replication. The effect of resource conservation practices was observed on yield attributes and yield in different cropping system. The highest growth attributes and yield was observed in mulching and 85% RDF+2.5 tonne/ha FYM treatments.

Keywords: Yield, mulching and FYM

Introduction
The issue of resource conservation have assumed importance in view of wide spread resource degradation and the need to reduce production cost, increase profitability and make agriculture more competitive. Resource conservation technologies will refer to those practices that enhance resource or input-use efficiency. Retaining and management of adequate amount of crop residue (at least 30%) under conservation agriculture is the key to realize long term benefits and also to reverse the process of soil degradation. Retention of crop residue as mulch improves organic carbon content, water stable aggregates, bulk density, hydraulic conductivity and reduces runoff. Crop responses to organic and biological sources of nutrients are not spectacular as to fertilizers, but the supplementary and complementary use of these resources is known to enhance the use efficiency of applied fertilizer besides improving soil physicochemical properties and preventing emergence of micro – nutrient deficiencies. In cereal- based cropping systems, about 25-50% fertilizer NPK dose of rainy season crops could be curtailed with the use of organics such as FYM, green manure and crop residues. The organic matter or crop residue helps to recycle the nutrients to correct their deficiencies. Studies indicated that use of organic sources can help maintain a better N:P ratio and higher yield. Incorporation of organic sources at much higher rates had been found useful but may not be affordable by small or low-income farmers.

Materials and Methods
Kharif season received total rainfall of 567.1 mm and 895.13 mm during 2017 and 2018, respectively. Similarly the winter crop in *Rabi* season received total rainfall of 15.8 mm and 38.00 mm during 2017-18 and 2018-19 respectively. The *kharif* season crop the mean relative humidity 98% (27th week) and 97% (31th week) was recorded maximum while it was found minimum 51% (40th week) and 40% (40th week) during 2017-18 and 2018-19 respectively. In *Rabi* season crops availed maximum relative humidity 98% (1st week) and 90% (48th, 50th and 6th week) against minimum of 23 (16th week) and 34% (47th and 52th week) during 2017-18 and 2018-19 respectively. The experimental field was prepared after pre-sowing irrigation at proper moisture condition.

First ploughing was done with tractor drawn disk harrow fallowed by cross ploughing with tractor drawn cultivator. Planking was done after each ploughing to make the field leveled and to conserve the soil moisture for the better germination of the seed. The crop was fertilized as per the treatment. The recommended dose of nitrogen, phosphorus and potassium @ 150 kg, 60 kg and 40 kg ha^{-1} for maize and wheat, 20 kg, 60 kg, and 40 ka ha^{-1} for field pea and 80 kg, 60 kg, and 40 ka ha^{-1} for mustard respectively. All the intercultural operations including irrigation, thinning, weeding, fertilization, harvesting and threshing were done as per critical time of crop requirement during both year. Mulching was done once at 20 DAS manually with the help of paddy straw. The crop was harvested at proper stage of maturity as determined by visual observations. Half meter length on either end of each plot and 2 border rows from each side as border were first removed from the field to avoid error. The crop in net plot was harvested for calculation of yield data. Produce was tied in bundles and weighted for biomass yield

Result and discussion

Effect of different treatments on yield attributes

Maize

The yield attributing character of maize recorded non significant difference. The use of organic mulch exhibited significant response in terms of increasing number of cobs/m^2 (2.5%) and cob length (2.54%) compared to no mulch treatment. This may proved the usefulness of organic mulch in incremental growth of yield attributing character of maize due to availing more moisture at critical growth stages, enhancing metabolic process (photosynthesis, food production and food storage).

Among nutrient management practices 85% RDF + 2.5 tonne FYM treatment recorded more number of cobs/m^2 (10.48%) and cob length (10.61%)) compared to 70% RDF + 5 tonne/ha FYM treatment.

This may established the superiority and appropriateness of mineral + organic nutrition over the nutrition provided through only mineral sources (100% RDF), because FYM supplemented not only trace element but also improve the availability of major nutrients provided through RDF doses. Similar findings were reported by Verma *et al.* (2018) [7]

Wheat

In wheat crop mulching play a significant role in increasing length of ear (4.92%) and number of grains/ear (4.19%) compared to no mulch treatment.

Among nutrient management 85% RDF +2.5 tonne/ha FYM established its superiority in increasing length of ear (10.20%) and number of grains/ear (9.03%) followed by 100%RDF treatment recorded increment in length of ear (4.63%), and number of grains/ear (4.43%) compared to 70% RDF + 2.5 tonne/ha FYM treatment. The results are in accordance with the findings of Shabnum *et al.* (2010) and Zahoor (2014) [4, 9].

Field pea

Organic mulch significantly improve length of pod and number of seed/pod of field pea compared to no mulch treatment and the magnitude of increment recorded in number of seed/pod **(**8.38%) and length of pod (7.60%). This may established the role of organic mulch in conserving soil moisture as well as check germination of weed seed and their development.

Among nutrient management treatments the combination of 85% RDF + 2.5 tonne/ha FYM during *Kharif* season recorded increment in number of pod (19.01%) and length of pod (28.60%) compared to 70% RDF + 5 tonne/ha FYM treatment.

Mustard

In mustard crop the response of mulching was the non significant manner while mineral as well as organic nutrition in mustard exhibited significant response in increasing yield attributing characters.

The treatment 85% RDF + 2.5 tonne/ha FYM evaluated enhancement in number of siliquae/plant (11.95%) and length of siliquae (4.52%) compared to 70% RDF + 5 tonne/ha FYM treatment. Similar finding were reported by Yadav *et al.* (2011) [6].

Effect of different treatments on yield

Maize

Organic mulch treatment registered increment in grain yield (3.09%) compared to no mulch treatment. The organic mulch not only conserves soil moisture but also lead efficient utilization by crop plants with the suppression of weed germination and growth. The ultimate result visible in enhancing yield of maize crop.

The combination of mineral + organic nutrition (85%RDF + 2.5 tonne/ha FYM) significantly increase yield of maize to the tune of 13.08% grain yield compared to 70% RDF + 5 tonne/ha FYM treatment. This combination of mineral + organic source of nutrition also proves its superiority over only mineral nutrition provided through 100% RDF treatment. The results are corroborated with the findings of Gaur and Kumawat (2004) and Manjhi *et al.* (2016) [1, 2].

Wheat

In moisture conservation practices organic mulch established its usefulness in significant improvement in grain yield of wheat. The magnitude of variation evaluated 7.30% in grain yield of wheat compared to no mulch treatment.

The treatment 85% RDF + 2.5 tonne/ha FYM registered significant improvement in yield compared 70% RDF + 5 tonne/ha FYM treatment. The magnitude of variation evaluated 17.90% in grain yield of wheat compared to 70% RDF + 5 tonne/ha FYM treatment. Similar findings were reported by Prasad *et al.* (2003) [3].

Field pea

Mulching treatment recorded increment in yield which varied to the tune of 7.82% seed yield. 85%RDF + 2.5 tonne/ha FYM treatment proved appropriate combination of mineral +organic nutrition recorded significant improvement in yield of field pea compared to 70% RDF + 5 tonne/ha FYM treatment as well as 100%RDF treatment.

The increment recorded in 20.47% in seed yield and 14.09% in straw yield under 85% RDF + 2.5 tonne/ha FYM treatment compared to 70%RDF + 5 tonne/ha FYM.

Mustard

Mulching in mustard recorded increment upto in 6.28% in seed yield yield compared to no mulch treatment.

Among nutrient management treatment 85% RDF + 2.5 tonne/ha FYM treatment recorded significant improvement in yield and the magnitude of variation recorded upto 11.74% in seed yield compared to 70% RDF + 5.0 tonne/ha FYM treatment. The results are in accordance with the findings of Verma *et al.* (2011) and Singh *et al.* (2011) [6, 5]

Table 1: Effect of different treatments on yield attributes and yield of maize

Treatments	Maize								
	Number of cob/m^2			Cob length (cm)			Yield (kg/ka)		
	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled
A. Cropping system									
Maize-Wheat	18.14	18.30	18.22	18.25	18.45	18.35	4445.30	4573.60	4509.50
Maize-Field pea	18.19	18.32	18.26	18.26	18.41	18.33	4515.70	4647.20	4581.40
Maize-Mustard	18.19	18.39	18.29	18.27	18.44	18.32	4459.20	4589.70	4524.40
SEd±	0.22	0.27	0.17	0.27	0.26	0.19	76.90	103.1	64.30
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
B. Moisture conservation practices									
Mulching	18.39	18.58	18.48	18.45	18.68	18.56	4538.20	4681.20	4609.70
No mulching	17.96	18.10	18.03	18.07	18.19	18.10	4408.60	4525.70	4467.20
SEd±	0.16	0.19	0.12	0.13	0.19	0.12	62.20	62.00	43.60
CD at 5%	0.39	0.47	0.27	0.32	0.46	0.25	152.20	151.80	95.60
C. Nutrient management									
100% RDF	17.93	18.09	18.01	17.98	18.19	18.09	4357.20	4485.00	4421.10
85% RDF + 2.5 t/ha FYM	19.21	19.39	19.29	19.36	19.50	19.39	4818.50	4940.80	4879.10
70% RDF + 5.0 t/ha FYM	17.38	17.54	17.46	17.44	17.61	17.53	4244.50	4384.70	4314.60
SEd±	0.18	0.19	0.13	0.19	0.15	0.12	75.90	82.80	58.50
CD at 5%	0.37	0.39	0.28	0.39	0.31	0.26	156.70	170.80	123.50
D. Interactions									
A×B×C									
SEd±	0.44	0.47	0.32	0.47	0.37	0.30	185.80	202.70	143.30
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2: Effect of treatments on yield attributes of wheat and field pea

Treatments	Wheat						Field pea					
	Length of ear (cm)			Number of grain/ear			Length of pod (cm)			Number of seed/pod		
	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled
A. Moisture conservation practices												
Mulching	10.16	10.28	10.22	55.05	56.85	55.95	6.91	6.97	6.94	6.09	6.21	6.16
No mulching	9.67	9.80	9.74	52.69	54.70	53.70	6.42	6.47	6.45	5.67	5.78	5.73
SEd±	0.09	0.10	0.07	0.50	0.47	0.34	0.07	0.08	0.05	0.07	0.10	0.06
CD at 5%	0.41	0.46	0.20	2.16	2.05	0.95	0.28	0.34	0.14	0.31	0.42	0.17
B. Nutrient management												
100% RDF	9.87	10.03	9.95	53.75	55.78	54.76	6.53	6.60	6.56	5.69	5.83	5.76
85% RDF + 2.5 t/ha FYM	10.43	10.53	10.48	56.36	58.08	57.22	7.58	7.63	7.60	6.81	6.90	6.86
70% RDF + 5.0 t/ha FYM	9.44	9.58	9.51	51.50	53.46	52.48	5.89	5.94	9.91	5.15	5.27	5.21
SEd±	0.10	0.09	0.07	1.03	0.70	0.62	0.10	0.11	0.07	0.10	0.14	0.09
CD at 5%	0.23	0.21	0.14	2.37	1.62	1.32	0.22	0.25	0.16	0.23	0.33	0.18
C. Interactions												
A×B												
SEd±	0.14	0.13	0.10	1.45	0.99	0.88	0.13	0.16	0.10	0.14	0.20	0.12
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3: Effect of treatments on yield attributes of mustard

Treatments	Mustard					
	Number of silique/plant			Length of silique (cm)		
	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled
A. Moisture conservation practices						
Mulching	324.73	330.23	327.48	6.40	6.53	6.46
No mulching	312.13	318.86	315.50	6.23	6.34	6.28
SEd±	3.45	3.68	2.52	0.05	0.07	0.04
CD at 5%	NS	NS	7.00	NS	NS	0.12
B. Nutrient management						
100% RDF	318.23	323.78	321.00	6.22	6.33	6.27
85% RDF + 2.5 t/ha FYM	336.83	342.92	339.87	6.80	6.92	6.86
70% RDF + 5.0 t/ha FYM	300.23	306.95	303.59	5.92	6.06	5.99
SEd±	4.08	5.73	3.52	0.10	0.11	0.08
CD at 5%	9.40	13.21	7.46	0.24	0.25	0.16
C. Interactions						
A×B						
SEd±	5.77	8.11	4.98	0.15	0.16	0.11
CD at 5%	NS	NS	NS	NS	NS	NS

Table 4: Effect of different treatment on yield of different crops

Treatments	Wheat			Field pea			Mustard		
	Grain yield (kg/ha)			Grain yield (kg/ha)			Grain yield (kg/ha)		
	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled
A. Moisture conservation practices									
Mulching	4719.60	4865.80	4792.20	1871.30	1909.30	1890.30	1865.00	1909.30	1887.20
No mulching	4398.30	4534.00	4466.20	1740.30	1765.70	1753.00	1756.30	1795.00	1775.70
SEd±	61.90	72.50	47.60	71.50	59.70	46.60	57.00	36.70	33.90
CD at 5%	270.10	316.10	132.30	NS	NS	129.30	NS	NS	94.00
B. Nutrient management									
100% RDF	4408.50	4577.70	4493.10	1762.50	1792.00	1777.30	1773.50	1812.50	1793.00
85% RDF + 2.5 t/ha FYM	5023.30	5143.00	5083.20	2000.00	2030.00	2015.00	1930.00	1976.50	1953.20
70% RDF + 5.0 t/ha FYM	4245.00	4377.50	4311.20	1655.00	1690.50	1672.80	1728.50	1767.50	1748.00
SEd±	114.20	100.00	75.90	88.90	91.00	63.60	64.50	63.10	45.10
CD at 5%	262.90	230.30	160.80	204.90	209.60	134.90	148.60	145.30	95.70
C. Interactions									
A×B									
SEd±	161.40	141.40	107.30	125.80	128.70	90.00	91.30	89.20	63.80
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS

Conclusion

On the basis of result it is concluded that the mulching and 85% RDF + 2.5 tonne/ha FYM treatments combinations improved yield attributes and grain yield in different cropping system as compared to no mulch and 70% RDF + 5.0 tonne/ha FYM treatments during two years of experiment.

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