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Effect of Wheat Residue Management and Fertilizer Levels on Growth, Quality, Weed and Yield of Summer Pearl Millet [*Pennisetum glaucum* (L.) R. Br.] under North Gujarat Condition

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A B S T R A C T

A field experiment was conducted during the summer seasons of 2017 and 2018 on loamy sand soils of Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat to assess the effect of wheat residue management and fertilizer levels on growth, quality, weed and yield of summer pearl millet [*Pennisetum glaucum* (L.) R. Br.] under North Gujarat conditions. The results indicated that among the wheat residue management treatments, harvesting through combine harvester and straw incorporate in soil + decomposer fungal consortia (1 lit/t) + 25 kg N/ha (R_6) enhanced the growth parameters, quality and yield *viz.*, dry matter production and CGR, protein content grain and straw yield of pearl millet. Among wheat residue management treatments, harvesting through combine harvester and burning the straw (R_2) recorded significantly lower weed density and dry weight of weeds at 20 DAS in pearl millet. Application of 120 : 60 : 00 kg N : P_2O_5 : K_2O/ha (100 per cent RDF) to pearl millet significantly improved growth parameters, quality and yield, while, significantly lower weed density and dry weight of weeds recorded under 50 per cent RDF.

Introduction

In less affluent countries such as South and South East Asia, grains are directly used for human consumption and crop residues are the main source of cattle feed apart from their usage as thatching of dwelling huts and cattle shed. Crop residues are certainly an asset in these countries and seldom left in the field. In India, 516 million tonnes (mt) crop residues were produced, among that 122 and 110 mt dry rice and wheat straw were generated (MOSPI, 2013-14). Total crop residue burned 129.07 mt, out of that 30.65 rice straw and 27.58 mt wheat straws may end up in field burning. In Gujarat, total crop residue production was about 22.9 mt, among that 5.73 mt was burned out in the field (Devi *et al.*, 2017). Pearl millet commonly known as [*Pennisetum glaucum* (L.) R. Br.] *Bajra* or *Bajri* is the staple food for millions of people in the arid and semi-arid tropics of the world.

It is well adapted to production systems characterized by drought, low soil fertility and high temperature. Because of its tolerance to adverse growing conditions, it can be grown in areas where other cereal crops, such as maize would not survive. India is the largest producer of pearl millet, the crop occupied an area of 8.69 million hectares with annual production of 10.05 million tonnes and average productivity of 1157 kg/ha. Pearl millet is an exhaustive crop which needs to be supplied with high doses of inorganic fertilizers to meet the nutritional requirements of the crop.

In recent days, due to the use of combine harvester, crop residues are largely remained in the field which must be managed to provide the greatest advantage possible, especially for water conservation, erosion control and maintenance of soil organic matter.

The residues of cultivated crops significantly improve the physical, chemical and biological properties along with overall quality of soil (Kumar and Goh, 2000) and consequently result in better establishment of crop. Wheat residues contain 6.2 kg N, 1.1 kg P, 18.9 kg K, 9-11 kg S, 100 g Zn, 777 g Fe and 745 g Mn per tonnes of straw (Van Duivenbooden, 1992) which is a valuable nutrient source for crop production.

In recent past, microbial cultures are used for residue management, which helps in easy decomposition of residues through secretion of enzymes which facilitates speedy bioconversion of organic waste into bio-stabilized compost and release nutrients with a minimum adverse effect on the environment apart from their beneficial role in disease management and promoting plant growth.

Materials and Methods

A field experiment was carried out during summer seasons of the year 2017 and 2018 at Agronomy Instructional Farm, Department of Agronomy, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, to study the effect of wheat residue management and fertilizer levels on Growth, yield attributes and yield of summer pearl millet [*Pennisetum glaucum* (L.) R. Br.] under North Gujarat conditions. The soil of the experimental plot was loamy sand in texture having pH (7.43 and 7.38 during 2017 and 2018 respectively) and EC (0.14 and 0.12 dS/m during 2017 and 2018 respectively). Analysis showed that the experimental soil was low in organic carbon (0.176 and 0.191 per cent during 2017 and 2018 respectively) and available nitrogen (155.20 and 156.11 kg/ha during 2017 and 2018 respectively) and medium in phosphorus (37.76 and 38.43 during 2017 and 2018 respectively) and potassium status (255.19 and 253.23 kg/ha during 2017 and 2018).

There were twenty-one treatment combinations comprising of seven residue management practices no residue incorporation (manual harvesting) (R_1), Wheat harvesting through combine harvester and burning the straw (R_2), Wheat harvesting through combine harvester and straw incorporation in soil (R_3), Wheat harvesting through combine harvester and straw incorporation in soil + 5 kg *T. viride* + 25 kg N/ha (R_4), Wheat harvesting through combine harvester and straw incorporation in soil + 5 kg madhyam + 25 kg N/ha (R_5), Wheat harvesting through combine harvester and straw incorporate in soil + decomposer fungal consortia (1 lit/t) + 25 kg N/ha (R_6) and Wheat harvesting through combine harvester and straw incorporate in soil + decomposer bacterial consortia (1 lit/t) + 25 kg N/ha (R_7) as a main plot treatment along with three fertilizer levels as a sub-plot treatment *viz*., 50 per cent RDF (F_1), 75 per cent RDF (F_2) and 100 per cent RDF (F_3). The experiment was laid out in split plot design with three replications. The required quantity of nitrogen

and phosphorus were calculated as per the treatments (F_1, F_2 and F_3) in form of urea and DAP, respectively.

The entire quantity of phosphorus (RDF) in the form of DAP and half quantity of nitrogen in the form of urea were applied prior to sowing in the opened furrows and furrows were lightly covered with soil after fertilizer application in all plots. The remaining dose of nitrogen was applied as top dressing in two equal splits at 30 and 45 DAS. All other cultural practices were performed uniformly for all treatments. Pearl millet hybrid "GHB 732" was sown on 21st March and 13th March during 2017 and 2018, respectively using recommended seed rate of 3.75 kg/ha keeping 45 cm distance between two rows. The intra row spacing of 15 cm approximately was maintained by thinning. Weeding and plant protection measures were undertaken as per the need and the required plant population was maintained.

The observations were recorded during course of study including dry matter accumulation, RGR, CGR, protein content of pearl millet grain, weed density, dry weight of weeds and yield. The collected data for various parameters were statistically analyzed using Fishers' analysis of variance (ANOVA) technique and the treatments were compared at 5% level of significance.

Results and Discussion

Effect of residue management

Growth, quality, weed parameters and yields of pearl millet were significantly influenced due to different residue management practices. Wheat harvesting through combine harvester and straw incorporation in soil + decomposer fungal consortia (1 lit/t) + 25 kg N/ha (R_6) recorded significantly higher dry matter production at 30 DAS (5.27 g/plant), at 45 DAS (26.85 g/plant) and at 60 DAS (51.13 g/plant), CGR (21.31g/m^2/day between 30-45 DAS) and (23.98 g/m^2/day between 45-60 DAS), protein content in grain (11.19 per cent) in pooled results, respectively (Table 2).

Different residue management treatments exhibited their non-significant effect on relative growth rate between 30-45 and 45-60 DAS, While, Wheat harvesting through combine harvester and burning the straw (R_2) recorded significantly lower weed density (8.34 numbers/m^2), dry weight of weeds (8.38 g/m^2) (Table 1).

Crop residue burning is considered as a controversial residue management option due to associated environmental hazards, yet it can deplete weed seed bank by destroying viable seeds in the soil. Similar results were reported by Khaliq *et al.,* (2015).

A significant increase in grain yield observed under these treatments because, straw incorporation with microbial inoculants leads to faster decomposition of straw, improved the status of soil organic matter, leading to higher uptake of available nutrients from soil and ultimately increased the growth and yield components.

The present findings are in close agreement with the results obtained by Shafi *et al.,* (2007) and Rajkhowa and Borah (2008), Mbah and Nneji (2011), Amgain *et al.,* (2013) and Choudhary *et al.,* (2016).

Effect of fertilizer levels

Application of 100 per cent RDF (F_3 - 120:60:00 kg NPK/ha) recorded significantly higher dry matter production at 30 DAS (5.02 g/plant), at 45 DAS (25.34 g/plant) and at 60 DAS (47.78 g/plant), CGR (20.07 g/m^2/day between 30-45 DAS and 22.16 g/m^2/day between 45-60 DAS), protein content to the tune of 11.20 per cent.

Table.1 Effect of wheat residue management and fertilizer levels on Growth attributes of summer pearl millet (pooled data)

Treatments	Dry matter accumulation (g/plant)			RGR (g/g/day)		CGR (g/m^2/day)	
	at 30 DAS	At 45 DAS	At 60 DAS	At 30-45 DAS	At 45-60 DAS	At 30-45 DAS	At 45-60 DAS
Wheat residue management (R):							
R_1	4.16	21.39	40.62	0.0475	0.0186	17.01	18.99
R_2	4.04	20.95	39.22	0.0478	0.0183	16.70	18.05
R_3	4.51	21.46	41.07	0.0453	0.0188	16.74	19.37
R_4	4.59	22.44	42.63	0.0461	0.0186	17.63	19.94
R_5	4.85	23.49	45.47	0.0459	0.0191	18.42	21.70
R_6	5.27	26.85	51.13	0.0474	0.0186	21.31	23.98
R_7	4.62	22.95	43.23	0.0466	0.0184	18.10	20.03
S.Em.±	0.10	0.35	0.54	0.0006	0.0004	0.34	0.50
C.D. at 5%	0.29	1.01	1.59	NS	NS	0.98	1.47
C.V. %	9.07	6.47	5.33	5.53	9.46	7.93	10.53
Fertilizer levels (F):							
F_1	4.20	20.54	39.60	0.0460	0.0190	16.14	18.82
F_2	4.52	22.49	42.64	0.0468	0.0185	17.75	19.90
F_3	5.02	25.34	47.78	0.0472	0.0184	20.07	22.16
S.Em.±	0.05	0.17	0.32	0.0004	0.0002	0.17	0.29
C.D. at 5%	0.14	0.49	0.92	NS	NS	0.50	0.81
Interaction (R × F):							
S.Em.±	0.13	0.46	0.85	0.0010	0.0006	0.46	0.76
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS
C.V. %	7.20	4.89	4.83	5.14	8.24	6.30	9.15

Table.2 Effect of wheat residue management and fertilizer levels on quality, weed density, dry weight of weeds and yield of summer pearl millet (pooled data)

Treatments	Protein (%)	Weed density at 20 DAS (Numbers/m^2)	Dry weight of weeds (g/m^2) at 20 DAS	Grain yield (kg/ha)	Straw yield (kg/ha)
Wheat residue management (R):					
R_1	10.67	12.55	13.47	3145	6027
R_2	10.56	8.34	8.38	2830	5584
R_3	10.71	13.60	15.77	3204	6581
R_4	10.75	16.02	17.90	3516	6776
R_5	11.06	17.20	24.95	4134	7665
R_6	11.19	16.68	22.45	4281	8064
R_7	10.79	15.61	20.04	3788	7316
S.Em.±	0.08	0.43	0.38	63	150
C.D. at 5%	0.24	1.27	1.10	186	438
C.V. %	3.20	12.87	9.11	7.61	9.29
Fertilizer levels (F):					
F_1	10.51	13.98	16.10	3169	6195
F_2	10.74	14.31	17.59	3580	6893
F_3	11.20	14.57	19.02	3921	7489
S.Em.±	0.04	0.21	0.14	34	73
C.D. at 5%	0.10	NS	0.41	99	206
Interaction (R × F):					
S.Em.±	0.09	0.56	0.38	92	193
C.D. at 5%	NS	NS	NS	261	NS
C.V. %	2.13	9.59	5.34	6.37	6.90

Table.3 Interaction effect of wheat residue management and fertilizer levels on grain yield of summer pearl millet (pooled data)

Fertilizer levels	Wheat residue management						
	R_1	R_2	R_3	R_4	R_5	R_6	R_7
F_1	2764	2315	2915	2959	3842	3888	3500
F_2	3257	3053	3266	3579	3862	4186	3859
F_3	3416	3122	3429	4009	4698	4771	4004
S.Em.±	92						
C.D. at 5%	261						

Different fertilizer levels did not exert their significant influence on relative growth rate between 30-45 and 45-60 DAS. Weed density was not affected by fertility levels during the course of investigation. Though, application of fertilizers did not affect the germination status of weeds. The 50 per cent RDF (F_1) treatment had relatively lower dry weight of weeds (16.10 g/m^2). These results are in conformity with Owla *et al.*, (2015). Significantly higher grain yield (3921 kg/ha) and straw yield (7489 kg/ha) were recorded under higher level of fertilizer (100 % RDF). Improvement in grain yield of pearl millet with increase in fertilizer levels up to 100 per cent RDF under new hybrids which has more yield potential and more response to fertilizer levels. Highest grain yield of pearl millet under higher NPK levels (100 % RDF) could be traced to adequate nutrient availability as was observed from significant and positive association between grain yield and N uptake. Favourable conditions experienced by the crop under 100 per cent RDF in turn aided the plants to put

forth improved performance over lower levels of fertilizer 50 per cent RDF. These results are in conformity with the results obtained by Patel *et al.*, (2004), Tetarwal and Rana (2006), Ansari *et al.*, (2011), Sakarvadia *et al.*, (2012), Prasad *et al.*, (2014), Chouhan *et al.*, (2015), Reddy *et al.*, (2016) and Sharma *et al.*, (2017).

Interaction effect

Treatment combination R_6F_3 (wheat harvesting through combine harvester and straw incorporation in soil + decomposer fungal consortia (1 lit/t) + 25 kg N/ha + 100 % RDF) recorded significantly higher grain yield (4771 kg/ha), which was at par with treatment combination R_5F_3 only (Table 3). Whereas, treatment combination R_2F_1 (wheat harvesting through combine harvester and burning the straw + 50 % RDF) recorded lower grain yield of 2315 kg/ha.

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