

Analysis of wheat varieties in Tehri and Pithoragarh districts of Uttarakhand (India) for impact of green fodder harvest on grain and residue yields with and without berseem under different fertiliser management

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Introduction

Mixed crop-livestock farming is the predominant system of agriculture in the hilly region of Uttarakhand. Farmers in the hills generally depend on forest to feed their livestock. But in winter forest leaves are unavailable for feeding leading to acute nutrient stress in animals. Studies in other states by scientists (Singhal, Tripathy, Singh and Harika, 2006) revealed that cereal crops, if used as dual purpose crops (grains as food for humans and green fodder as feed for livestock), fodder shortage in the lean seasons can be reduced to a great extent. Hence a study was conducted to analyse the performance of two wheat varieties on fodder, grain and straw yields.

Impact of fodder harvest – the trial

To understand the impact of green fodder harvest on the grain and straw yield, an experiment was conducted in two field locations in Uttarakhand (village Thaeli of Tehri district situated at an altitude of 975 m AMSL and village Kothera of Pithoragarh district, altitude 1500-1550 m AMSL). The trial was carried out with two varieties of wheat (local and improved /VL 829). There were four treatments with berseem (sown together with wheat) and another set of the same four treatments without berseem (total eight treatments). The four treatments were: (1) no fodder cut; no fertiliser (2) fodder cut at 79/85 DAS; no fertiliser (3) fodder cut at 79/85 DAS with 100 kg urea (46 kg N) /ha after the cut (4) fodder cut at 79 /85 DAS with 6 MT FYM /ha after the cut. The plot size was 2m². There were four replications for each treatment and followed a complete randomised block design.

The wheat crop was sown (seed rate 100 kg/ha) along with berseem (seed rate 25 kg/ha) in the first location (Tehri) on Nov. 7, 2011 using seed drill. As per treatments, harvesting of crop for fodder was done at 79 days after sowing, followed by one critical irrigation and final harvest was done at 180 days after sowing.

In Pithoragarh the seeds were sown (broadcasting) on November 30, which was late by 45 days compared to the normal sowing season (mid-October) and fodder was harvested at 85 DAS. Here also one irrigation was given at 87th DAS and final harvest was done at 171 DAS.

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Findings

The data recorded during the experiment in the two regions are presented below.

I. TEHRI REGION

1. Non destructive and destructive observations at 79 DAS

In the Tables 1-2 non-destructive and destructive observations of the two varieties with and without berseem at **79 DAS** with and without Nitrogen /FYM are given:

It was observed (Table 1) that the number of plants and number of tillers were more in the improved variety than the currently cultivated local one. When fodder was cut at 79 DAS, the plants and tillers increased in number and the increase was more when urea was applied. When berseem was sown along with wheat it did not show much change in these parameters after fodder cut.

Table 1: Non-destructive observations of local and VL829 at 79 DAS

	No of wheat plants/m ²		No of berseem plants/m ²		Average 10 Plant Ht wheat (cm)		Average 10 Plant Ht berseem (cm)		No. of tillers/m ² wheat	
	Local	Improved	Local	Improved	Local	Improved	Local	Improved	Local	Improved
No berseem; No Cut; No Urea/FYM	25.25	53			23.08	32.05			160	248
No berseem; Cut; No Urea/FYM	63	52			23.5	29.9			232	278
No berseem; Cut + Urea @100 kg /ha plot	70	92			23.35	31.25			234	336
No berseem; Cut + FYM @6 MT /ha plot	61	131			24.1	26.65			232	314
With berseem; No Cut; No Urea/FYM	69	85	236	426	22.17	33.97	11.4	13.1	164	290
With berseem; Cut; No Urea/FYM	41	80	342	486	23.87	30.9	11.6	14.4	182	297
With berseem; Cut + Urea @100 kg /ha plot	38	111	358	335	25.1	31	12.8	13.5	139	229
With berseem; Cut + FYM @6 MT /ha plot	65	70	421	374	25.2	33.2	14	13.5	166	291

As far as the green fodder yield is concerned (Table 2) in the case of local varieties, it increased with urea application (in plots with and without berseem) and FYM application (in berseem plots). In the case of improved varieties, the yield was less in the rest of the treatments.

Table 2: Destructive observation of local and VL 829 at 79 DAS

	Green fodder yield at 79 DAS	
	Local	Improved
No berseem; Cut; No Urea/FYM	1.56	2.88
No berseem; Cut + Urea @100 kg /ha	1.88	2.72
No berseem; Cut + FYM @6 MT /ha	1.36	2.24
With berseem; Cut; No Urea/FYM	3.20	1.90
With berseem; Cut + Urea @100 kg /ha	2.22	1.72

With berseem; Cut + FYM @6 MT /ha	2.94	1.96
Mean (across 6 treatments, 24 replications)	1.73	2.75

2. Non destructive and destructive observations at 180 DAS

In the Tables 3-4 below non-destructive and destructive observations of the two varieties at 180 DAS with and without Nitrogen /FYM are given:

Table 3: Non-destructive observation of local Variety Vs VL 829 at 180 DAS

	Average 10 Plant Ht (cm)		Avg spike length (cm)		No. of tillers/m ²	
	Local	Improved	Local	Improved	Local	Improved
No berseem; No Cut; No Urea/FYM	97.15	85.05	11.3	11.1	245	336
No berseem; Cut; No Urea/FYM	95.5	85.63	11.3	10.8	271	317
No berseem; Cut + Urea @100 kg /ha plot	93.45	87.23	11.8	10.9	258	355
No berseem; Cut + FYM @6 MT /ha plot	90.9	87.925	11.4	11.72	263	325
With berseem; No Cut; No Urea/FYM	92.4	94.97	10.8	9.7	201	302
With berseem; Cut; No Urea/FYM	93.92	86.1	10.95	10.4	222	365
With berseem; Cut + Urea @100 kg /ha plot	91.4	85.1	11.3	10.8	230	344
With berseem; Cut + FYM @6 MT /ha plot	92.7	84.4	10.5	11.2	218	321

It is found that fodder harvest did not influence much on the plant height, spike length and number of tillers in both **local and improved varieties** with and without berseem (Table 3).

In the **local and improved varieties without berseem** the number of grains per spike and 1000 grain weight did not change much when fodder was cut with and without fertilizer /manure application. But with berseem there was reduction in both these characteristics in both the varieties (Table 4). Regarding the total biomass yield, it got reduced by about 30% in both local and improved varieties when fodder was cut at 79 days after sowing from plots with and without berseem (this is explained by removal of green fodder at the rate of 1.73 MT and 2.75 MT /ha from local and improved varieties respectively).

Table 4: Destructive observations at the time of harvest at 180 DAS

	Average no. of grains/spike		Average gram 1000 grain weight		Total Biomass t/ha	
	Local	Improved	Local	Improved	Local	Improved
No berseem; No Cut; No Urea/FYM	58.5	51	49.46	43.73	10.24	10.52
No berseem; Cut; No Urea/FYM	58	55.5	49.2	50.33	6.76	7.08
No berseem; Cut + Urea @100 kg /ha plot	54.5	57	50.19	49.15	7.78	6.5
No berseem; Cut + FYM @6 MT /ha plot	54.5	56.5	47.32	49.22	7.04	7.54
With berseem; No Cut; No Urea/FYM	46.53	41.60	41.54	38.35	6.75	11.02
With berseem; Cut; No Urea/FYM	49.6	45.9	45.22	41	6.4	9.02
With berseem; Cut + Urea @100 kg /ha plot	51.9	48.5	45.3	41.5	6.22	7.8

With berseem; Cut + FYM @6 MT /ha plot	45.7	47.5	43.8	43.1	5.06	6.56
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Impact of fodder harvest on grain and straw yield in Tehri

Statistical analysis carried out by GLM procedures using SAS (9.2) software revealed that between varieties (across all treatments) there is significant difference for green fodder yield (improved variety better) but the difference is not significant for grain and straw yields though they appear to be more in the case of improved variety (Table 5). It means harvest of green fodder can be recommended in both the varieties but it is strongly recommended in the case of improved variety as the quantity of fodder produced by the improved variety is higher and significant.

Table 5: Impact of varieties on green fodder, grain & straw yield

Varieties	Fodder (across all treatments)	Grain (across all treatments)	Straw (across all treatments)
Local variety	1.73	3.95	3.11
Improved variety	2.75	4.47	3.83
Overall mean (across treatments including no cut)	2.24	4.21	3.47
Probability (P)	0.0031	0.21	0.88
LSD	0.65		

If $P < 0.05$, significant at 5% level of significance; $P > 0.05$, NS

As far as the treatments are concerned (Table 6) both in the case of local and improved varieties, there is no significant impact on fodder, grain and straw yields among various treatments. However, though not significant, if farmers chose improved variety for dual purpose, the best treatment is found to be sowing wheat with berseem as it is found to yield more quantity of grains (5.32 MT) in comparison to other treatments. Whereas if they choose local variety for dual purpose, then they can go for urea application after fodder cut as it produces comparatively more quantity of grains (4.60 MT).

Table 6: Impact of treatments on green fodder, grain & straw yield

Treatments	Local Variety			Improved variety		
	Fodder	Grain	Straw	Fodder	Grain	Straw
No Berseem; Cut; Urea	1.88	4.60	3.18	2.72	3.60	3.20
No Berseem; Cut; FYM	1.36	4.22	2.82	2.24	3.98	3.56
No Berseem; Cut; No Urea/FYM	1.56	4.12	2.70	2.88	3.80	3.36
With Berseem; Cut; Urea	1.72	3.40	2.82	2.22	4.68	3.12
With Berseem; Cut; FYM	1.96	2.70	2.36	3.22	3.52	3.04
With Berseem; Cut; No Urea/FYM	1.90	3.38	3.02	3.20	5.32	3.70
Overall mean (across treatments excluding no cut)	1.73	3.73	2.81	2.75	4.15	3.33
Probability (P)	0.97	0.35	0.86	0.58	0.52	0.98

If $P < 0.05$, significant at 5% level of significance; $P > 0.05$, NS

The following Table (Table 7) summarises the analysis and help us to take a quick decision on the desirable variety in Tehri through a comparison of impact on straw and grain yield:

Table 7: Selection of variety and treatment – the decision matrix

1 (a)	Presently, local variety yields →	No Fodder	5.46 MT grain* 4.78 MT straw*
1 (b)	Local variety when cut at 79 DAS →	1.88 MT Fodder	Application of urea after fodder harvest (best treatment) will produce 4.60 MT grain and 3.18 MT straw
1 (c)	Improved variety when cut at 79 DAS →	3.20 MT Fodder (significant)	Sowing wheat with berseem (best treatment) will produce 5.32 MT grain and 3.70 MT straw

* Average of four replications of the treatment "no berseem, no cut, no urea /FYM"

The Table (7) above suggests that the farmers can be strongly advised to go for the improved variety (VL 829) and harvest about 3.20 MT of green fodder at 79 DAS and following the best treatment (sowing wheat with berseem) to have maximum grain yield.

II. PITHORAGARH REGION

1. Non destructive and destructive observations at 79 DAS

It was observed (Table 8) that before green fodder harvest the number of plants and tillers were more in the improved variety than the currently cultivated local one. When fodder was cut at 85 DAS, the plants and tillers of local variety increased in number in the berseem and non-berseem plots. In the case of improved variety though the no. of plants increased after cutting, the number of tillers got reduced in berseem and non-berseem plots.

Table 8: Non-destructive observations of local and VL829 at 85 DAS

	No of wheat plants/m ²		No of berseem plants/m ²		Average 10 Plant Ht wheat (cm)		Average 10 Plant Ht berseem (cm)		No. of tillers/m ² wheat	
	Local	Improved	Local	Improved	Local	Improved	Local	Improved	Local	Improved
No berseem; No Cut; No Urea/FYM	506	555			23.30	22.11			605	838
No berseem; Cut; No Urea/FYM	666	603			24.40	24.31			678.	682.
No berseem; Cut + Urea @100 kg /ha plot	658	523			25.83	24.33			725.	704
No berseem; Cut + FYM @6 MT /ha plot	564	623			22.95	24.94			575	767
With berseem; No Cut; No Urea/FYM	560	481	185	391	28.15	22.90	7.03	7.00	645	775
With berseem; Cut; No Urea/FYM	393	570	307	270	26.42	22.60	5.88	7.13	522	675
With berseem; Cut + Urea @100 kg /ha plot	359	821	296	365	26.90	23.50	5.96	7.50	634	755.
With berseem; Cut + FYM @6 MT /ha plot	755	482	321	302	26.50	22.10	7.10	6.87	860.	592.

As far as the green fodder yield is concerned (Table 9), the local variety produced more than the improved one. The yield of both varieties increased slightly across all treatments.

Table 9: Destructive observation of local and VL 829 at 85 days after sowing

	Green fodder yield at 85 DAS	
	Local	Improved
No berseem; Cut; No Urea/FYM	2.12	1.59
No berseem; Cut + Urea @100 kg /ha plot	2.36	2.36
No berseem; Cut + FYM @6 MT /ha plot	2.06	1.70
With berseem; Cut; No Urea/FYM	1.86	2.18
With berseem; Cut + Urea @100 kg /ha plot	2.28	1.69
With berseem; Cut + FYM @6 MT /ha plot	2.30	1.93
Mean (across 6 treatments, 24 replications)	2.16	1.92

2. Non destructive and destructive observations at 171 DAS

In the Tables 10-11 below non-destructive and destructive observations of the two varieties at **171 DAS** with and without Nitrogen /FYM are given.

Table 10: Non-destructive observation of local Variety Vs VL 829 at 171 DAS

	Average 10 Plant Ht (cm)		Avg spike length (cm)		No. of tillers/m ²	
	Local	Improved	Local	Improved	Local	Improved
No berseem; No Cut; No Urea/FYM	64.70	72.75	6.22	6.85	584	859
No berseem; Cut; No Urea/FYM	65.90	69.90	6.50	7.20	509	594
No berseem; Cut + Urea @100 kg /ha plot	59.30	66.70	5.62	6.22	630	719
No berseem; Cut + FYM @6 MT /ha plot	62.47	71.72	5.92	6.95	610	795
With berseem; No Cut; No Urea/FYM	63.93	66.70	6.30	6.70	676	818
With berseem; Cut; No Urea/FYM	60.78	74.30	6.32	6.95	567	715
With berseem; Cut + Urea @100 kg /ha plot	59.20	71.00	5.63	6.93	660	633
With berseem; Cut + FYM @6 MT /ha plot	63.60	76.00	5.75	7.00	719	575

It is found that fodder harvest did not influence much on the plant height, spike length and number of tillers in both **local and improved varieties** with and without berseem (Table 10).

In the **local and improved varieties** the number of grains per spike and 1000 grain weight did not change much across treatments when fodder was cut with and without fertilizer /manure application (Table 11). Regarding total biomass yield, it got reduced slightly in both local and improved varieties when fodder was cut at 79 days after sowing from plots with and without

berseem (this is mainly due to green fodder harvest at the rate of 2.16 MT and 1.92 MT /ha from local and improved varieties respectively).

Table 11: Destructive observations at the time of harvest at 171 DAS

	Average No. of grains/spike		Average gram 1000 grain weight		Total Biomass t/ha	
	Local	Improved	Local	Improved	Local	Improved
No berseem; No Cut; No Urea/FYM	47	48	28.03	39.43	9.60	10.44
No berseem; Cut; No Urea/FYM	47	44	30.00	38.78	8.14	9.72
No berseem; Cut + Urea @100 kg /ha plot	44	42	26.03	35.61	9.04	12.44
No berseem; Cut + FYM @6 MT /ha plot	45	46	28.14	39.02	7.63	10.70
With berseem; No Cut; No Urea/FYM	47	45	29.40	39.57	10.93	11.70
With berseem; Cut; No Urea/FYM	47	42	29.61	36.40	7.98	10.90
With berseem; Cut + Urea @100 kg /ha plot	44	46	25.50	39.20	9.50	11.10
With berseem; Cut + FYM @6 MT /ha plot	50	46	30.90	39.10	7.94	11.00

Impact of fodder harvest on grain and straw yield in Pithoragarh

Statistical analysis carried out by GLM procedures using SAS (9.2) software revealed that between varieties (across all treatments) there is significant difference in straw yield (improved variety better) but the difference is not significant for grain and fodder yields (Table 12). Therefore, cutting green fodder can be recommended in the case of improved variety as the quantity of straw produced by it is higher and significant (in the local variety also farmers can be advised to cut fodder as cutting has no significant impact on grain and straw yields)

Table 12: Impact of varieties on green fodder, grain & straw yield

Varieties	Fodder (across all treatments)	Grain (across all treatments)	Straw (across all treatments)
Local variety	2.16	4.31	4.51
Improved variety	1.92	4.26	6.44
Overall mean (across treatments including no cut)	2.04	4.29	5.48
Probability (P)	0.30	0.91	<0.0001
LSD			0.84

If P< 0.05, significant at 5% level of significance; P>0.05, NS

As far as the treatments are concerned (Table 13) both in the case of local and improved varieties, there is no significant impact on fodder, grain and straw yields among various treatments. However, though not significant, if farmers chose improved variety for dual purpose (as it has significant straw yield), the best treatment is found to be application of FYM after fodder cut as it is found to yield more quantity of grains (4.78 MT) in comparison to other treatments. Whereas if they choose local

variety for dual purpose, then they can go for urea application after fodder cut as it produces comparatively more quantity of grains (5 MT) among other treatments.

Table 13: Impact of treatments on green fodder, grain & straw yield

Treatments	Local Variety			Improved variety		
	Fodder	Grain	Straw	Fodder	Grain	Straw
No Berseem; Cut; Urea	2.36	5.00	4.04	2.36	4.24	5.86
No Berseem; Cut; FYM	2.06	3.84	3.79	1.70	4.78	5.92
No Berseem; Cut; No Urea/FYM	2.12	3.98	4.16	1.69	3.82	5.77
With Berseem; Cut; Urea	2.28	4.22	5.28	1.69	4.44	7.10
With Berseem; Cut; FYM	2.30	3.53	4.41	1.93	3.96	7.00
With Berseem; Cut; No Urea/FYM	1.86	3.48	4.50	2.18	3.62	7.30
Overall mean (across treatments excluding no cut)	2.16	4.01	4.36	1.92	4.14	6.49
Probability (P)	0.96	0.18	0.89	0.65	0.96	0.41

If $P < 0.05$, significant at 5% level of significance; $P > 0.05$, NS

The following Table (Table 14) summarises the analysis and helps us to take a decision on the desirable variety and treatment in Pithoragarh through a comparison of impact on straw and grain yield:

Table 14: Selection of variety and treatment – the decision matrix

1 (a)	Presently, local variety yields →	No Fodder	5.20 MT grain* 4.40 MT grain*
1 (b)	Local variety when cut at 85 DAS →	2.36 MT Fodder	Application of urea after fodder harvest (best treatment) will produce 5 MT grain and 4.04 MT straw
1 (c)	Improved variety when cut at 85 DAS →	1.70 MT Fodder	Application of FYM after fodder cut (best treatment) will produce 4.78 MT grain and 5.92 MT straw (straw significant)

* Average of four replications of the treatment “no berseem, no cut, no urea /FYM”

The Table (14) above suggests that farmers can harvest about 1.70 /2.36 MT of green fodder per ha in both the varieties without any significant reduction in grain yield. But the improved variety, in addition to green fodder, can also produce significantly higher quantity of straw (about 1.50 MT additional, compared to the local).

Conclusion

It can be concluded that, in TEHRI, harvesting fodder at 79 DAS of the improved variety VL 829 will be a boon to animal feeding as it produces significant quantity of additional green fodder (about

3.20 MT /ha) in the lean season without any significant reduction in the grain and straw yields. The best treatment to be followed to achieve this is 'sowing of berseem along with wheat'.

In PITHORAGARH also, farmers can grow the improved VL 829 variety and cut about 1.70 MT green fodder at 85 DAS. It will have no significant reduction of grain yield but will produce more straw (about 1.50 MT additional /ha). This is resulted by the best treatment 'application of FYM after fodder cut'.

Reference

Singhal, K. K., Tripathy, H. P., Sing, B. and Harika, A. S. 2006. *Evaluation of dual purpose wheat for grain and fodder production and the nutritive value of wheat fodder*. National Dairy Research Institute, Karnal, India.