

Analysis of barley varieties in Tehri and Pithoragarh districts of Uttarakhand, India for fodder, grain and residue yields under different management

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Introduction

In the hilly region of Uttarakhand, both in the irrigated and rainfed areas, the predominant system of agriculture is mixed crop-livestock farming. The farmers, mostly marginal, mainly depend on forest resources to feed their livestock. This sometimes contributes to degradation of forests in certain areas, particularly in the lean periods (summer and winter). But it is found that in the same regions some of the farmers cultivate barley (*Hordeum vulgare*) for fodder purpose (use of grain for human consumption was an earlier practice but discontinued later, despite being highly nutritious). Hence it is very clear that large scale promotion of dual purpose barley as a food-feed crop in the hills of Uttarakhand, can help addressing the fodder shortage issue (in the lean periods), reduce dependence on forest and increase food security. To catalyse the process awareness needs to be created among people to resume the use of barley grain as human food considering its nutritional value. With this intention, a trial was laid out to compare the local barley variety with a dual purpose variety (BHS 380) on fodder and grain yield under different fertiliser management.

Impact of fodder harvest – the trial

To understand the response of green fodder harvest at 75/80 days after sowing (DAS) a field experiment was conducted in two locations in Uttarakhand (village Thaeli of block Bhilangana of Tehri district situated at an altitude of 975 m AMSL and village Kothera of block Gangolihat of Pithoragarh district, altitude 1500-1550 m AMSL). The trial was carried out with two varieties (local and improved /BHS 380) and four treatments: (1) no cut; no fertiliser (2) cut at 75/80 DAS; no fertiliser (3) cut at 75/80 DAS with 100 kg urea (46 kg N) /ha after the cut (4) cut at 75/80 DAS with 6 MT FYM /ha after the cut. The plot size was 2m². There were four replications for each treatment and used complete randomised block design design.

The crop was sown (seed rate 100 kg/ha) in the first location (Tehri) on Nov. 7, 2011 by broadcasting (local variety) and using a seed drill (BHS 380). Three irrigations were given by the farmer: first during 2-3 days after sowing, second on 60 DAS and third on 76 DAS. As per treatments, harvesting of crop for fodder was done at 75 days after sowing leaving a stubble height of 5 cm. The final harvest was done at 165 DAS.

In Pithoragarh the seeds were sown (broadcasting) on December 2, which was late by 47 days compared to the normal sowing season (mid October) and fodder was harvested at 80 DAS. Here, one irrigation was given at 82 DAS. Final harvest was done at 159 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 75 DAS

In the Tables 1-2 below non-destructive and destructive observations of the two varieties at 75 DAS with and without Nitrogen /FYM are given:

Table 1: Non-destructive observations of local and BHS 380 at 75 DAS

	No Cut; No Fertiliser plot		Cut; No Fertiliser plot		Cut + Urea @100 kg /ha plot		Cut + FYM @6 MT /ha plot	
	Local	BHS 380	Local	BHS 380	Local	BHS 380	Local	BHS 380
Non-destructive observation at 75 DAS								
No of plants/m ²	88	113	85	120	107	104	134	104
No. of tillers/m ²	310	389	274	409	418	367	295	376
Average 10 Plant Ht (cm)	21.4	28.53	18.93	30.28	19.45	27.7	22.28	30.18

It was observed that the number of plants, plant height and number of tillers were more in the improved variety than the currently cultivated local one. Similarly the green fodder yield was much higher (85% more) in the improved variety compared to the local (Table 2).

Table2: Destructive observation of local and BHS 380 at 75 days after sowing

	Cut; No Fertiliser plot		Cut + Urea @100 kg /ha plot		Cut + FYM @6 MT /ha plot		Mean across 3 treatments, 12 replications	
	Local	BHS 380	Local	BHS 380	Local	BHS 380	Local	BHS 380
Destructive observation at 75 DAS								
Green Biomass at 75 DAS t/ha	1.58	3.62	1.76	3.78	2.71	3.62	2.02	3.67

2. Non destructive and destructive observations at 165 DAS

In the Tables 3-4 below non-destructive and destructive observations of the two varieties at 165 DAS with and without Nitrogen /FYM are given:

Table 3: Non-destructive observation of local Variety Vs BHS 380 at 165 DAS

	No Cut; No Fertiliser		Cut; No Fertiliser		Cut + Urea @100 kg /ha		Cut + FYM @6 MT /ha	
	Local	BHS 380	Local	BHS 380	Local	BHS 380	Local	BHS 380
Non Destructive observation at 165 DAS								
Average 10 plant height (cm)	92.2	80.85	87	78.43	89.85	78.58	92.05	73.58
Average 10 plant Spike length (cm)	6.68	3.593	6.475	3.75	5.8	3.675	6.275	3.725
No of tillers /m ²	362	446	327	474	494	435	365	439

It is found that the plant height, spike length and number of tillers in the **local variety** did not change much when fodder was cut and FYM was applied. With urea application, though the plant height and spike length reduced slightly, the number of tillers increased by 37%. When fodder is cut and no fertiliser /manure was applied all the three factors reduced to some extent. In the case of **improved variety**, there was not much change in plant height, spike length and number of tillers when fodder was cut with and without urea /FYM application (Table 3).

Table 4: Destructive Observations at the time of harvest

Destructive observation at 165 DAS	No Cut; No Fertiliser		Cut; No Fertiliser		Cut + Urea @100 kg /ha		Cut + FYM @6 MT /ha	
	Local	BHS 380	Local	BHS 380	Local	BHS 380	Local	BHS 380
Average No. of grains/spike	68.1	38.35	66.1	39	67.95	39	65.05	38.9
Average gram 1000 grain weight	26.1	35.74	24.09	35.34	25.51	35.55	22.94	35.15
Total Biomass t/ha	9.67	12.17	9.25	11.97	9.86	12.09	9.44	11.92

In the **local variety** the number of grains per spike and 1000 grain weight reduced slightly when fodder was cut with and without fertilizer /manure application (Table 4). But the reduction was less when urea was applied after fodder harvest.

Impact of fodder harvest on grain and straw yields in Tehri

Statistical analysis revealed that (Table 5) between varieties there is significant difference in fodder, grain and straw yield (improved variety better).

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

	Varieties		
	Fodder	Grain	Straw
Local variety	2.01	3.74	5.81
Improved variety	3.67	4.44	7.59
Overall mean (across treatments including no cut)	2.84	4.09	6.70
Probability (P)	0.0006	0.0001	0.004
LSD	0.84	0.26	1.16

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

As far as the treatments are concerned (Table 6), the improved variety produced maximum quantity of grains when urea was applied (4.78 MT). In the local variety also, though insignificant, maximum grain yield was noted when urea was applied after fodder harvest

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

Treatments	Local Variety			Improved variety		
	Fodder	Grain	Straw	Fodder	Grain	Straw
Cut; Urea	1.76	3.89	5.97	3.78	4.78	7.31
Cut; FYM	2.71	3.69	5.75	3.62	4.11	7.81
Cut; No Urea/FYM	1.59	3.55	5.72	3.62	4.5	7.47
Overall mean (across treatments excluding no cut)	2.02	3.71	5.81	3.67	4.46	7.52
Probability (P)	0.004	0.55	0.98	0.98	0.04	0.88
LSD	0.6				0.51	

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

The following Table (15) summarises the analysis and helps us to take a decision on the desirable variety in Pithoragarh through a comparison of impact on grain and straw yield with and without fertiliser /manure application after fodder harvest at 75 DAS:

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

1 (a)	The present Local variety yields →	No fodder	3.83 MT grain* 5.84 MT straw*
1 (b)	Local variety when cut at 75 DAS →	1.76 MT fodder	Application of urea FYM (best treatment) will produce 3.89 MT grain and 5.97 MT straw
1 (c)	Improved variety BHS 380 when cut at 75 DAS →	3.78 MT fodder (significant)	Application of urea (best treatment) will produce 4.78 MT grain and 7.31 MT straw (significant)

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

Between the two varieties, BHS 380 is the one that can be recommended as it produces substantially higher quantities of grains and straw besides 3.78 MT of green fodder during lean season.

II. PITHORAGARH REGION

1. Non destructive and destructive observations at 75 DAS

In the Tables 8-9 below non-destructive and destructive observations of the two varieties at 80 DAS with and without Nitrogen /FYM are given:

Table 8: Non-destructive observations of local and BHS 380 at 80 DAS

	No Cut; No Fertiliser plot		Cut; No Fertiliser plot		Cut + Urea @100 kg /ha plot		Cut + FYM @6 MT /ha plot	
	Local	BHS 380	Local	BHS 380	Local	BHS 380	Local	BHS 380
Non-destructive observation at 80 DAS								
No of plants/m ²	942	1084	1040	1085	981	983	742	918
No. of tillers/m ²	903	1190	1049	1090	962	1001	1211	1300
Average 10 Plant Ht (cm)	21.56	18.83	22.13	18.25	19.26	21.62	20.59	18.59

It was observed that the number of plants and plant height were more in the improved variety than the currently cultivated local one. But average plant height and green fodder yield was more in the local variety.

Table 9: Destructive Observation of local and BHS 380 at 80 days after sowing

	No Cut; No Fertiliser plot		Cut; No Fertiliser plot		Cut + Urea @100 kg /ha plot		Cut + FYM @6 MT /ha plot		Mean across 3 treatments and 12 replications	
	Local	BHS 380	Local	BHS 380	Local	BHS 380	Local	BHS 380	Local Average	BHS 380 Average
Destructive observation at 80 DAS										
Green Biomass at 80 DAS t/ha	0	0	1.88	1.28	1.66	1.01	1.86	2.2	1.8	1.49

2. Non destructive and destructive observations at 159 DAS

In the Tables 10-11 below non-destructive and destructive observations of the two varieties at **159 DAS** with and without Nitrogen /FYM are given:

Table 10: Non-destructive observation of local Variety Vs BHS 380 at 159 DAS

	No Cut; No Fertiliser		Cut; No Fertiliser		Cut + Urea @100 kg /ha		Cut + FYM @6 MT /ha	
	Local	BHS 380	Local	BHS 380	Local	BHS 380	Local	BHS 380
Non Destructive observation at 159 DAS								
Average 10 plant height (cm)	61.02	57.11	65.17	56.34	64.5	57.96	65.37	55.48
Average 10 plant Spike length (cm)	5.72	4.72	5.54	4.73	5.37	4.76	4.88	5.2
No of tillers /m2	1084	1115	1343	1211	1195	1112	1312	1391

In the **local variety** it was found that while the plant height and number of tillers increased in all the treatments, the spike length got reduced in all cases. In the case of **improved variety**, there was not much change in plant height, spike length and number of tillers except in the case of FYM application, which resulted in an increase of spike length by 10% and number of tillers by 25%.

Table 11: Destructive observations at the time of harvest

	No Cut; No Fertiliser		Cut; No Fertiliser		Cut + Urea @100 kg /ha		Cut + FYM @6 MT /ha	
	Local	BHS 380	Local	BHS 380	Local	BHS 380	Local	BHS 380
Destructive observation at 159 DAS								
Average No. of grains/spike	44.05	45.05	50.7	44.4	47.05	44	44.85	48.3
Average gram 1000 grain weight	36.33	34.18	39.55	33.84	37.66	36.71	33.46	38.53
Total Biomass t/ha	7.33	21.62	11.7	21	11.02	22.26	10.38	19.88

In the **local variety** the number of grains per spike, 1000 grain weight and total biomass increased in all the treatments with maximum effect when no urea /FYM was applied followed by cut with urea and cut with FYM application (with the exception of reduction in 1000 grain weight with FYM application). In the **improved variety** the total biomass increased with urea application, grains per spike increased with FYM application and 1000 grain weight increased with urea and FYM application.

Impact of fodder harvest on grain and straw yields in Pithoragarh

Statistical analysis revealed that (Table 12) between varieties there is significant difference in grain and straw yield (improved variety better) but the difference is not significant for green fodder production.

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

Varieties			
	Fodder	Grain	Straw
Local variety	1.80	4.77	5.34
Improved variety	1.50	6.99	14.19
Overall mean (across treatments including no cut)	1.65	5.88	9.76
Probability (P)	0.23	0.008	<0.0001
LSD		1.59	2.78

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

As far as the treatments are concerned (Table 13) the improved variety produced maximum quantity of grains when no urea or FYM is applied (7.23 MT), followed by application of urea after cut (6.84 MT). The local variety is also found to produce maximum grains when no urea/FYM was applied after fodder harvest

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

Treatments	Local Variety			Improved variety		
	Fodder	Grain	Straw	Fodder	Grain	Straw
Cut; Urea	1.66	4.86	6.16	1.01	6.84	15.4
Cut; FYM	1.87	5.4	4.98	2.20	5.84	14.03
Cut; No Urea/FYM	1.89	6.2	5.5	1.28	7.23	13.80
Overall mean (across treatments excluding no cut)	1.80	5.48	5.54	1.50	6.63	14.40
Probability (P)	0.87	0.74	0.88	0.02	0.60	0.79
LSD				0.83		

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

The following Tables (14) summarise the analysis and help us to take a decision on the desirable variety in Pithoragarh through a comparison of impact on grain and straw yield with and without fertiliser /manure application after fodder harvest at 80 DAS:

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

1 (a)	The present! Local variety yields →	No fodder	2.62 MT grain* 4.71 MT straw*
1 (b)	Local variety when cut at 80 DAS →	1.89 MT fodder	No application of urea /FYM (best treatment) will produce 6.20 MT grain and 5.50 MT straw
1 (c)	Improved variety (BHS 380) when cut at 80 DAS →	1.28 MT fodder	No application of urea /FYM (best treatment) will produce 7.23 MT grain and 13.80 MT straw (significant)

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

Between the two varieties, the improved BHS 380 is the one that can be recommended as it produces substantially higher quantity of grain and straw besides 1.28 MT of green fodder during lean season.

Conclusion

It can be concluded that, both in TEHRI and PITHORAGARH, the improved variety BHS 380 performed better in terms of fodder, grain and straw yields. The performance in terms of grain and straw yield was commendable in Pithoragarh compared to Tehri. While the best treatment to get best result (from the improved variety) In Tehri was 'application of urea after fodder cut', that in Pithoragarh was 'no application of urea /FYM'. Though the later treatment effect is insignificant, It is felt that it needs to be further explored.