Fodder species and varieties pilot in high altitude areas of Gilgit and Chitral Regions

Pilot progress and assessment report 2021

Prepared

By

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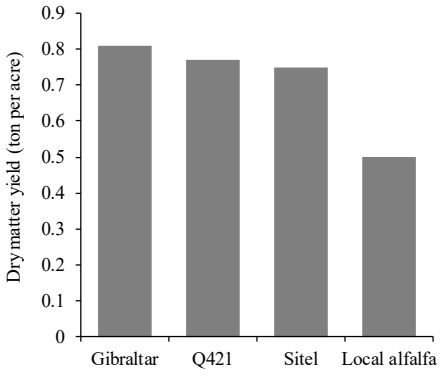
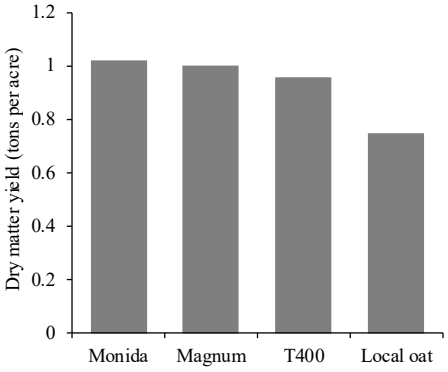
Table of Contents

Graphical Abstract

Aim of pilot study	Participatory testing and selection of high-yielding fodder varieties for Gilgit-Baltistan and Chitral (GB&C) to adopt and address winter fodder shortages
Methodology	Alfalfa and oat fodder varieties, seed selection and sowing, research site establishment, farmers field days, interviews, and data collection and analysis  
Time and locations	April to September 2021, various parts of GB&C
Results	Alfalfa variety Gibraltar showed good plant growth and gave the highest fodder yield. Oat varieties Monida and Magnum also gave the highest fodder yield  
Recommendations	• The Alfalfa variety *Gibraltar* and Oat variety *Monida* are recommended for fodder production and upscaling in the GB&C • Build capacity of field staff to undertake scientific and adaptive research, data collection, data analysis, and report writing  

1. Background

Fodder is is a food input to feed domesticated livestock. And livestock is an important source of food for human lives (plain and mountains) through the supply of milk and meat but most importantly it asset for farmers on rainy days. In Pakistan, including mountain areas, the livestock population is almost 163 million which is increasing by 4.2% annually but the fodder area is decreasing 2% in each decade (source…). The area under fodder cultivation in Pakistan is about 2.5 million hectares with an annual production of 55 million tons. The average production is 24 tons per hectare which is too low to meet the fodder shortage in the country. The requirement for fodder increases over time. A regular and adequate supply of nutritious fodder is important for the rearing and development of livestock. For livestock, fodder crops are the cheapest and main source of feed. Green fodders are also highly digestible, palatable and an economic source of nutrients for dairy animals. However, fodder production is the major limiting factor in our country, in particular for mountains communities, to rear livestock. There is a big difference between the demand and supply of fodder. Researchers and forage breeders need to play a significant role in developing high-yielding, highly nutritive, multi-cut varieties or hybrids of different fodder crops so that the gap between fodder demand and supply is reduced.

The mountainous farming community of the Gilgit Baluchistan and Chitral (GB&C) is based on a subsistence farming system that is highly complex and not linear. Here, the development and management of natural resources are mainly determined by traditional practices of communities. Rapid population growth, multiple uses of cultivated land, and the emergence of other off-farm economic opportunities in the region have led to changes in the management and stress of natural resources. Changes in availability and division of labour and land affected agriculture mainly due to an increase in male out-migration, increase in education level and decrease in landholding. However, agriculture is still the key employment and livelihoods source for the majority of people across GB&C. Commercialization of agriculture, including processing and marketing, has remained a challenge despite progress at various fronts, particularly in implementing commercially oriented development activities in GBC. This is mainly due to fragmented production units and small-scale operations.

High altitude villages and single cropping zones are faced with additional challenges of market access, productivity, and diversification. Most of the resource-poor valleys identified under the Central Asia Poverty Project have single cropping zones, which makes field crops (wheat and maize) production relatively less attractive and least feasible.

AKRSP, AKF, ICIMOD, and Lanzhou university used to deliberate on sustainable use of natural resources in particular with the view from food and nutrition security of high altitude mountain communities in Hindu kush Karakoram and Pamir. Fodder production has remained central to this discussion.

2. Rationale

AKRSP has a very long history of supporting agriculture activities. Improved seed varieties including potato and vegetable production along with the supply of sheep/Zomos/milking cows to poor households are some of the historic interventions alongside on-farm training of farmers. The impact of the interventions has been positive on the economy, household, and resource-poor areas. However, despite the severe shortage of fodder in long and severe winters, improved fodder production was initially not included in mainstream activities, especially for high-altitude areas.

The shortage of fodder is one of the important concerns of the community. Almost every household in remote, isolated, and high-altitude valleys faces this problem. The stall feeding starts in October and continues till May. This is a crucial time when farmers need fodder stock and animals need food to survive

severe winters. Due to fodder shortages, many farmers are compelled to sell their animals at minimum prices. The adverse impact of fodder shortage poor household nutrition and poverty is very high. To address this issue, the Aga Khan Rural Support Programme (AKRSP) in collaboration with the International Center for Integrated Mountain Development (ICIMOD) and International Cooperation Hub of Mountain Eco-agriculture of Gansu Province (ICHMEA), Lanzhou University, China, developed a pilot program to explore the potential for high-value crop and fodder production in these affected areas.

3. Objectives of pilot

- Select high yielding fodder varieties through participatory screening of improved fodder varieties applicable in high altitude areas of GBC
- Plant the seeds and test the efficacy of the varieties for productivity and performance
- Recommend best varieties for fodder production on a commercial scale and household consumption
- Fulfill farmers' demand for fodder in the winter season
- Build capacities of farmers on improved fodder production
- Create evidence for scaling efforts, partnership, and investments

4. Methodology

4.1. Seed selection:

Considering the rationale, AKRSP in collaboration with ICIMOD and ICHMEA conducted participatory varietal selection trials of six fodder varieties (three alfalfa and three oat varieties) from China. Initially, 30 research trials of these varieties were planned for different altitudes (high, mid, and low) but due to the late arrival of seed, only 18 research trials (12 in Gilgit and 6 in Chitral) were conducted at different high-altitude sites of the Gilgit and Chitral valleys.

4.2. Establishment of Research sites

The climate of Gilgit-Baltistan varies from one mountain range to another so as the sharp variations in weather. The eastern part has the moist zone of the western Himalayas, but the climate gets considerably drier toward the Karakoram and the Hindu Kush Himalayas. The altitudes of trial sites are between 9 to 10 thousand feet.

To evaluate the performance of these varieties, sites with fertile land were selected in different geographical zones. Initially, 30 sites were planned in high altitude and low land areas for fodder trails but it did not happen due to the late arrival of seed from China and the time taken for clearance of seed by the customs office in Lahore. By the time seed arrived, cultivation of cereals and potato crops was completed in lowlands and partially in upper areas. This led to a reduction of the number of trials with more focus on high altitude areas of Gilgit and Chitral. Table 1 shows the location and trial sites.

Table 1: Research trial sites in Chitral, Gilgit, and Upper Hunza.

S. No.	**Name of site**	**Cropping Zone**	**Altitude**
Chitral			
1	Sur Laspur	Single	8500 ft
2	Yarkhun Lasht	do	8500 ft
3	Boroghil	do	9000 ft
4	Khot	do	8500 ft
5	Gobor	do	8000 ft

6	Booni	Transitory	7000 ft
Ghizer, Gilgit			
1	Bilhanz Karumber	Single	8150 ft
2	Mujawer Karumber	do	7835 ft
3	Faizabad Ishkomen	do	7734 ft
4	Dawood Abad Ishkomen	do	7734 ft
5	Barkulti Yasin	do	8200 ft
6	Umalsat Yasin	do	8200 ft
7	Gulagmuli Teru	do	10,200 ft
Upper Hunza			
1	Shersabz Upper Hunza	Single	9700ft
2	Zoodkhoond Upper Hunza	do	9900
3	Ispanj Upper Hunza	do	9700
4	Shimshal center Upper Hunza	do	9200

Field days were organized for farmers in surrounding villages during seedbed preparation, sowing, germination, maturity, and harvesting. During the field days, the field agriculturist demonstrated crop management techniques to farmers and gathered their feedback.

The field agriculturist also frequently visited the trial sites to record the number of irrigations, disease incidences, insect attacks, and weed infestation. The owner of the land was provided remuneration for irrigation and taking care of crops till their maturity. The agriculturist then prepared a report based on field visits, farmers' feedback during different stages of fodder crops, and information was collected in the format shown below. The different varieties of oat and alfalfa included in the trial are shown in Table 2.

Feedback of farmers against different variables was recorded during field visits/field days organized for the farmers. The variables were plant height, biomass weight, maturity period, leaf size, and stem softness. Farmers thoroughly examined the standing crop and compared it with their local fodder.

Table 2: List of Oat and Alfalfa Lucerne varieties.

Foder species	**Name of variety**
Oat	
1	Magnum
2	Monida
3	T400
4	Local
Lucerne	
1	Gibraltar
2	Sitel
3	421Q
4	Local

4.3. Farmer Field days (multi-locations)

During land preparation, seed sowing, maturity, and harvesting of the crop, the field days were organized for the farmers in all locations for the physical observation of the crop. Farmers' capacities were built around seedbed preparation, seed sowing, application of farmyard manure to crop, irrigations, diseases, insect pests, harvesting, drying, storage, and data collection. A total of 292 households (Male 182 and 110 Females) benefited from these trials and around 1800 to 2000 farmers indirectly benefited from these trials. During field days, farmers and AKRSP field staff shared their experiences on fodder production. The plot owner was assigned the day-to-day management of the crop, and he was fully trained in all aspects of crop management. The following variables were measured during field days.

1. Germination percentage
2. Amount of irrigation
3. Leaf size and stem hardiness
4. Plant height
5. Fresh weight and dry weight

4.4. Data collection, variables, and analysis

Field data were collected on the following variables at each location and averaged to conclude the results.

Variable	Unit definition for data collection
Seed germination	Seed germination was studied for each variety at each location using standard seed germination techniques
Plant Growth	At the time of harvest, plant height (ft) of 10 randomly selected plants of each species per location was recorded using a measuring tape and averaged
Fresh Biomass Yield	Fresh biomass yield per plot was measured in kilograms after harvesting plants of each species. The yield in kilograms was converted into MT/Acre.
Dry Fodder yield	Each fresh fodder sample was sun-dried. The dried plant materials were was further weighed to estimate the dry fodder yield of each variety at each location. Below are the data of the Alfalfa varieties of each location.

Overall summary of results/finding of Alfalfa varieties

The overall summary of data collated on germination, plant growth, and biomass yields are presented in Table 3 and 4.

Seed germination

Seed germination was studied for each variety at each location using standard seed germination techniques. The data (Table 4) shows maximum germination of the Gibraltar variety (89. 30%), followed by Q421 (86.86%) and Sitel (83.74%). Germination was lowest for variety local (82.74%).

Plant Growth

Among Alfalfa varieties, maximum plant height was recorded for Gibraltar (1.85 ft), followed by Sitel (1.796) while the minimum was observed for Q421 (1.66 ft) and local (1.50 ft). Local also had thin stems with fewer leaves.

Average Fresh Biomass Yield

Fresh biomass yield measured in kgs was converted into MT/Acre after harvesting plants of each species. Alfalfa species Gibraltar gave the highest yield (2.36 MT), followed by Q421 (2.24 MT) while Sitel gave the lower yield (2.22 MT). The yield was lowest for the local variety (1.71 MT). Gibraltar variety performed well, followed by Q421.

Average Dry Biomass Yield

Alfalfa variety Gibraltar gave the highest dry matter yield (0.81 MT), followed by Q421 (0.77 MT). Sitel gave a lower dry biomass yield (0.74 MT). Dry matter yield was the lowest for the local variety (0.50 MT). Gibraltar variety performed well, followed by Q421.

Table 3: Alfalfa varieties and their performances at Ghizer, Chitral, and Nunza.

Variety	Av. Germination %	Av. Plant Height (ft)	Fresh Average Yield MT/Acre	Average Dry Yield (MT/Acre
Ghizer				
Sitel	76.629	1.779	2.498	0.748
Q421	89.571	1.786	2.681	0.835
Gibraltar	87.143	1.779	2.796	0.858
Local	77.143	1.317	1.830	0.472
Chitral				
Q421	87.500	1.750	2.105	0.695
Gibraltar	92.500	1.903	2.069	0.683
Local	88.333	1.639	1.587	0.524
Nunza				
Sitel	86.250	1.775	2.095	0.812
Q421	83.500	1.450	1.923	0.771
Gibraltar	88.250	1.875	2.221	0.874

Table 4: Overall data summary of Alfalfa varieties.

Variety	**Av. Germination %**	**Av. Plant Height(ft)**	**Fresh Average Yield (MT/Acre)**	**Av. Dry Yield (MT/Acre)**
Sitel	83.737	1.796	2.220	0.747
Q421	86.857	1.662	2.236	0.767
Gibraltar	89.298	1.852	2.362	0.805
Local	82.738	1.478	1.708	0.498

Summary of results of Oat varieties

The field data on seed germination, plant growth, and biomass yields are presented in Table 5. The overall performance of oat varieties from different locations is presented in Table 6.

Seed germination

Seed germination of each oat variety at different locations was studied using standard seed germination techniques. Maximum germination was recorded for Magnum variety (89. 95%), followed by Monida (89.15%) and variety T400 (87.15%). Germination was the lowest for the local oat variety (76.73%).

Plant Growth

Among Oat varieties, maximum plant height was recorded for the local variety (2.29 ft), followed by Monida (2.29 ft). The minimum plant height was observed for Magnum (2.27 ft) and T400 (2.11 ft). The main stem of the local variety was thin and had fewer leaves as compared to improved oat varieties.

Average Fresh Biomass Yield

Fresh biomass yield measured in kilogram was converted into MT/Acre after harvesting. The maximum fresh biomass yield was recorded for Monida (3.03 MT), followed by Magnum (2.99 MT) and T400 (2.89

MT). The minimum yield was recorded for the local variety (2.25 MT). Monida variety performed excellent, followed by Magnum.

Average Dry Biomass Yield

Dry biomass yield measured in kilogram was converted into MT/Acre after harvesting. Oat species Monida gave the highest yield (1.02 MT), followed by Magnum (1.00 MT) and T400 (0.96 MT). Dry matter yield was the lowest for the local variety (0.75 MT). Monida variety performed best, followed by Magnum.

Table 5: Germination, plant growth, and biomass yields of oat varieties at Ghizer, Chitral, and Hunza.

Variety	**Av. Germination %**	**Av. Plant Height(ft)**	**Fresh weight (MT/Acre)**	**Dry weight (MT/Acre)**
Ghizer				
Magnum	91.429	2.896	2.916	0.977
T400	90.286	2.836	2.819	0.944
Monida	89.286	2.879	2.778	0.931
Local	79.286	2.680	1.963	0.658
Chitral				
Magnum	89.167	2.264	3.504	1.174
T400	84.167	2.056	3.489	1.169
Monida	86.667	2.167	3.650	1.223
Local	74.167	1.903	2.528	0.847
Hunza				
Magnum	89.250	1.650	2.552	0.855
T400	87.000	1.425	2.300	0.771
Monida	91.500	1.825	2.658	0.890

Table 6: Overall data summary of oat varieties.

Variety	**Av. Germination %**	**Av. Plant Height(ft)**	**Fresh Average Yield (MT/Acre)**	**Average Dr Yield (MT/Acre)**
Magnum	89.948	2.270	2.991	1.002
T400	87.151	2.105	2.869	0.961
Monida	89.151	2.290	3.029	1.015
Local	76.726	2.291	2.246	0.752

Farmers' perceptions and assessment of alfalfa and oat varieties in the Gilgit region

Farmers' perceptions and assessment of alfalfa and oat varieties in the Gilgit region are presented in Tables 7 and 8. Farmers mentioned that winter is long and harsh in the Gilgit region, which made it difficult to feed animals in winter. The majority of farmers sold one or two large animals when returning from summer pastures to the village, due to a severe shortage of fodder for animals. Wheat straw and kitchen waste are normally fed to the animals. Animals sometimes died due to severe colds and fodder shortages. The new fodder varieties of Alfalfa and Oat from China, introduced in our area, are perceived by farmers as a good initiative to resolve the issue of fodder shortages in winter.

Secondly, the farmer field days organized were found to be another encouraging activity to share experiences, practically comparing and selecting varieties for further multiplication. The performance in

terms of production, softness, and leaf size of improved varieties is said to be better than the local varieties. The better performing varieties are highly recommended in this area.

Table 7: Farmers' perceptions of improved Alfalfa and Oat varieties.

SL No	Question	Yes	No	Don't know
1	Are improved fodder species better than local fodder?	✓		
2	Do you face fodder shortage in winter?	✓		
3	Do you think that improved fodder species will alleviate the fodder scarcity problem in your area?	✓		

Table 8: Farmers' assessment of improved Alfalfa and Oat varieties

Question
1. If yes, please explain why improved varieties are better than the local species? *Ans:* Because the improved varieties have the potential to be used as fodder after their adaptability at the tested locations.
2. Which improved fodder variety is the best? *Ans:* Magnum and Gibraltar are best based on plant height and fresh biomass yield among Oat and Alfalfa species, respectively.
3. Would you cultivate improved fodder species? *Ans:* Due to the lack of cultivable lands in the area, farmers cannot allocate specific land areas for fodder cultivation. However, enough sloping areas are available for cultivations. This crop is good to protect soil erosion as well.
4. Mention months of fodder scarcity in your area. *Ans:* January, February, March, November, and December
5. Would you like to make hay or silage? Please provide reason *Ans:* Yes, to avoid fodder scarcity in our area during the winter season.

Key Recommendations

- The improved fodder varieties of Oat and Alfalfa gave good production results as compared to the local varieties in high-altitude areas of Gilgit-Baltistan and Chitral. Among improved varieties, the Alfalfa variety Gibraltar and Oat variety Monida are recommended for upscaling.
- More trial plots in transitory and double cropping zones need to be conducted to further examine the production and other parameters of improved varieties. For upscaling these varieties, the seed needs to be produced at the local level to ensure the availability of seed for cultivation on large scales.
- The seed of improved fodder varieties must be arranged in time to prevent delay in sowing.
- Capacity building of field staff is needed in scientific and adoptive research, data collection, data analysis, and report writing. Staff from Government Agriculture, livestock departments, and PARC need to be involved in this joint venture.

Acknowledgments

We appreciate AKRSP, ICIMOD, and Lanzhou University for supporting this joint venture. We hope to arrange seeds of these varieties for seed production and cultivation on large scale.

Annexure 1: Field data analysis of alfalfa varieties at different locations in Ghizer region of Gilgit-Baltistan

Beneficiary Name	Village	Name of oat varieties	Germination %	Plant height (ft)	Plot Size (Sq.ft)	Fresh weight (kg)	Dry weigh t (kg)	Fresh weight (T/Acre)	Dry weight (MT/Acre)
Aziz Khan		Sitel	95	2	210	11.05	3.15	2.29	0.65
		Q421	95	2	210	12.25	3.63	2.54	0.75
	Mujawir	Gibraltar	95	2	210	12.05	3.68	2.50	0.76
		Local	80	1.5	210	8.05	2.05	1.67	0.43
Aflatoon	Bilhanz	Sitel	90	1.6	160	8.5	2.85	2.31	0.78
		Q421	90	1.5	160	9.45	3.08	2.57	0.84
		Gibraltar	90	1.6	160	10.05	3.07	2.74	0.84
		Local	80	1	160	5.5	1.51	1.50	0.41
Eid Khan	Jalal abad	Sitel	95	2	340	18.5	5.27	2.37	0.68
		Q421	95	2.3	340	21	6.22	2.69	0.80
		Gibraltar	95	2.5	340	20.85	6.58	2.67	0.84
		Local	85	2	340	11.05	2.82	1.42	0.36
Jan Ali	Dawood Abad	Sitel	95	2	160	8.75	2.49	2.38	0.68
		Q421	95	2	160	9.5	2.91	2.59	0.79
		Gibraltar	95	2	160	10.5	3.21	2.86	0.87
		Local	85	1.5	160	7.65	1.87	2.08	0.51
Muzaffar Hussain	Bakolti Bala	Sitel	80	1.6	200	12.95	3.95	2.82	0.86
		Q421	85	1.3	200	12.7	3.76	2.77	0.82
		Gibraltar	80	1.2	200	11.5	3.51	2.50	0.77
		Local	70	1	200	8.25	2.10	1.80	0.46
Sher faraz	Umalset	Sitel	1.4	1.5	184	11.5	3.28	2.72	0.78
		Q421	82	1.75	184	12.05	3.92	2.85	0.93
		Gibraltar	75	1.65	184	13	3.97	3.08	0.94
		Local	70	1.02	184	9.75	2.49	2.31	0.59
Jan Nadir	Khunandeh	Sitel	80	1.75	160	9.5	3.01	2.59	0.82
		Q421	85	1.65	160	10.12	3.39	2.76	0.92
		Gibraltar	80	1.5	160	11.85	3.62	3.23	0.99
		Local	70	1.2	160	7.5	2.01	2.04	0.55

Annexure 2: Field data analysis of oats varieties sown at different locations in Ghizer region of Gilgit-Baltistan

Beneficiary Name	Village	Name of oat varieties	Germination %age	Plant height(ft)	Plot Size (Sft)	Fresh weight (kg)	Dry weight (kg)	Fresh weight MT/Acre	Dry weight MT/Acre
		Magnum	90	3.3	210	16.5	5.53	3.42	1.15
		T400	90	2.8	210	17.05	5.71	3.54	1.18
Aziz Khan	Mujawir	Monida	90	3	210	16.75	5.61	3.47	1.16
		Local	75	3	210	10.5	3.52	2.18	0.73
Aflatoon	Bilhanz	Magnum	90	2.8	160	12.95	4.34	3.53	1.18
		T400	89	3	160	12.25	4.10	3.34	1.12
		Monida	90	2.6	160	10.05	3.37	2.74	0.92
		Local	80	3.01	160	7.5	2.51	2.04	0.68
Eid Khan	Jalal abad	Magnum	95	3.02	340	12.95	4.34	1.66	0.56
		T400	95	3.1	340	11.75	3.94	1.51	0.50
		Monida	90	3	340	12.25	4.10	1.57	0.53
		Local	85	2.5	340	9.02	3.02	1.16	0.39
Jan Ali	Dawood Abad	Magnum	95	2.5	160	11.75	3.94	3.20	1.07
		T400	90	2.5	160	10.95	3.67	2.98	1.00
		Monida	90	3	160	10.5	3.52	2.86	0.96
		Local	85	2.8	160	7.65	2.56	2.08	0.70
Muzaffar Hussain	Bakolti Bala	Magnum	90	2.65	200	12.95	4.34	2.82	0.94
		T400	90	2.8	200	12.7	4.25	2.77	0.93
		Monida	90	3	200	11.5	3.85	2.50	0.84
		Local	80	2.65	200	9.5	3.18	2.07	0.69
Sher faraz	Umalset	Magnum	90	3	184	11.5	3.85	2.72	0.91
		T400	90	3.15	184	12.05	4.04	2.85	0.96
		Monida	90	2.75	184	13	4.36	3.08	1.03
		Local	80	2.3	184	8.55	2.86	2.02	0.68
Jan Nadir	Khunandeh	Magnum	90	3	160	11.25	3.77	3.06	1.03
		T400	88	2.5	160	10.12	3.39	2.76	0.92
		Monida	85	2.8	160	11.85	3.97	3.23	1.08
		Local	70	2.5	160	8.05	2.70	2.19	0.73

Annexure 3: Field data analysis of alfalfa varieties sown at different locations in Chitral KPK

B. name	Village	Varieties of Alfalfa	Germination (%)	Plant height (ft)	Plot Size (Sft)	Fresh weight (Kg)	Dry weight (Kg)	Fresh weight MT/Acre	Dry weight MT/Acre
Muhammad Wazir Khan	Sor Laspur	Sitel	90	1.92	680	32.56	10.7448	2.09	0.69
		Q421	90	1.92	680	31.45	10.3785	2.01	0.66
		Gibraltar	95	2.08	680	32.05	10.5765	2.05	0.68
		Local	80	1.50	680	24.45	8.0685	1.57	0.52
Zar Wali Khan	Yarkhun Lasht	Sitel	90	1.83	680	33.65	11.1045	2.16	0.71
		Q421	90	1.75	680	34.45	11.3685	2.21	0.73
		Gibraltar	95	1.92	680	30.8	10.164	1.97	0.65
		Local	80	1.54	680	25.9	8.547	1.66	0.55
Shamsiar	Pech Ouch	Sitel	80	1.75	680	32.56	10.7448	2.09	0.69
		Q421	80	1.67	680	30.95	10.2135	1.98	0.65
		Gibraltar	85	1.83	680	32.55	10.7415	2.09	0.69
		Local	90	1.75	680	24.8	8.184	1.59	0.52
Nisar Ali Khan	Puchang	Sitel	95	1.92	680	32.85	10.8405	2.10	0.69
		Q421	95	1.75	680	33.45	11.0385	2.14	0.71
		Gibraltar	95	1.83	680	30.55	10.0815	1.96	0.65
		Local	95	1.71	680	25.45	8.3985	1.63	0.54
ARSS	Booni Lasht	Sitel	85	1.75	680	30.56	10.0848	1.96	0.65
		Q421	85	1.67	680	33.45	11.0385	2.14	0.71
		Gibraltar	90	1.83	680	35.05	11.5665	2.25	0.74
		Local	90	1.75	680	23.5	7.755	1.51	0.50
Abdul Murad	Merdin	Sitel	90	1.83	680	31.25	10.3125	2.00	0.66
		Q421	85	1.75	680	33.45	11.0385	2.14	0.71
		Gibraltar	95	1.92	680	32.75	10.8075	2.10	0.69
		Local	95	1.58	680	24.5	8.085	1.57	0.52

Annexure 4: Field data analysis of oat varieties sown at different locations in Chitral KPK

Beneficiary name	Village	Varieties of Oats	Germination (%)	Plant height (ft)	Plot Size (Sqft)	Fresh weight (Kg)	Dry weight (Kg)	Fresh weight MT/Acre	Dry weight MT/Acre
Muhammad Wazir Khan	Sor Laspur	Magnum	90	2.25	680	55.2	18.49	3.54	1.18
		T400	85	2.08	680	54.75	18.34	3.51	1.17
		Monida	85	2.17	680	65.25	21.86	4.18	1.40
		Local	70	1.92	680	35.2	11.79	2.25	0.76
Zar Wali Khan	Yarkhun Lasht	Magnum	90	2.17	675	52.33	17.53	3.38	1.13
		T400	85	2.00	675	53.75	18.01	3.47	1.16
		Monida	85	2.08	675	55.02	18.43	3.55	1.19
		Local	75	1.83	675	38.5	12.90	2.48	0.83
Shamsiar	Pech Ouch	Magnum	80	2.00	684	55.75	18.68	3.55	1.19
		T400	80	1.83	684	57.25	19.18	3.65	1.22
		Monida	80	1.92	684	56.3	18.86	3.59	1.20
		Local	65	1.67	684	40.25	13.48	2.56	0.86
Nisar Ali Khan	Puchang	Magnum	95	2.42	675	51.75	17.34	3.34	1.12
		T400	90	2.25	675	50.55	16.93	3.26	1.09
		Monida	90	2.33	675	52.1	17.45	3.36	1.13
		Local	80	2.08	675	39.52	13.24	2.55	0.85
ARSS	Booni Lasht	Magnum	90	2.50	688	55.75	18.68	3.53	1.18
		T400	85	2.17	688	54.32	18.20	3.44	1.15
		Monida	90	2.33	688	58.2	19.50	3.68	1.23
		Local	80	2.00	688	41.75	13.99	2.64	0.89
Abdul Murad	Merdin	Magnum	90	2.25	672	56.95	19.08	3.69	1.24
		T400	80	2.00	672	55.7	18.66	3.61	1.21
		Monida	90	2.17	672	54.6	18.29	3.54	1.19
		Local	75	1.92	672	41.2	13.80	2.67	0.89

Annexure 5: Field data analysis of alfalfa varieties sown at different locations in Hunza region of Gilgit-Baltistan

Village	Name of Alfa Alfalfa Varieties	Plot size (sft)	Fresh Weight(kg)	Dry Weight (kg)	Dry Weight (kg)	Fresh weight MT/Acre	Dry weight MT/Acre
Shere Sabz	Sitel	110	6.55	2.19	2.19	2.59	0.87
	Q421	110	5.5	1.84	1.84	2.18	0.73
	Gibraltar	110	7.45	2.50	2.50	2.95	0.99
Ispanj	Sitel	55	3.52	1.18	1.18	2.79	0.93
	Q421	55	3.25	1.09	1.09	2.57	0.86
	Gibraltar	55	3.5	1.17	1.17	2.77	0.93
Zoodkhoon	Sitel	75	4.02	1.35	1.35	2.33	0.78
	Q421	75	3.75	1.26	1.26	2.18	0.73
	Gibraltar	75	4.1	1.37	1.37	2.38	0.80
Shimshal Center	Sitel	225	10.25	3.43	3.43	1.98	0.66
	Q421	225	11.75	3.94	3.94	2.27	0.76
	Gibraltar	225	12.05	4.04	4.04	2.33	0.78

Annexure 6: Field data analysis of oats varieties sown at different locations in Hunza region of Gilgit-Baltistan

B. Name	Varieties	Germination %	Plant Height(ft)	Plot Size	Fresh Weight(kg)	Dry Weight (kg)	Fresh weight MT/Acre	Dry weight MT/Acre
Ali Rehman	Magnum	92	1.60	350	20	6.70	2.49	0.83
	T400	90	1.40	350	18	6.03	2.24	0.75
	Monida	95	1.80	350	22	7.37	2.74	0.92
Abdul Karim	Magnum	90	1.50	300	18	6.03	2.61	0.88
	T400	88	1.30	300	16	5.36	2.32	0.78
	Monida	93	1.60	300	19	6.37	2.76	0.92
Afzal Khan	Magnum	78	1.20	270	15	5.03	2.42	0.81
	T400	75	1.00	270	13	4.36	2.10	0.70
	Monida	80	1.40	270	16.75	5.61	2.70	0.91
Sifat Karim	Magnum	97	2.30	300	18.5	6.20	2.69	0.90
	T400	95	2.00	300	17.5	5.86	2.54	0.85
	Monida	98	2.50	300	16.75	5.61	2.43	0.81

Field Pictures

Figure 1. sowing of alfalfa trial plots at Gobor Chitral

Figure 2. Harvesting of Oat at Khot Trial plot at Chitral

Figure 3. Lucerne Trial plot at Yarkhon at Chitral

Figure 4. Farmers' assessment at Chitral

Figure 5. Measuring plant height

Figure 6. Farmer field days at Ghizer Immit

Figure 7. Agriculturist giving lecture during field day at Teru

Figure 8. Agriculturist demonstrating land preparation at Yasin

Figure 9. Oat trial plot at Ghizer Ishkomen

Figure 10. Seed mixing with sand for sowing