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Afghanistan Water, Agriculture, and Technology Transfer (AWATT) Program



Forage Foundation Seed Production Performance Evaluation Report

Submitted to MAIL/Kabul for Production of Certified Seeds by MAIL

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ABBREVIATIONS AND TERMS

AWATT	Afghanistan Water, Agriculture and Technology Transfer
Canal	In this and all AWATT documents, the word “ canal ” refers to either a secondary or tertiary canal. ¹
CSU	Colorado State University
<i>jerib</i>	Unit of land area approx. 0.2 hectare
MAIL	Ministry of Agriculture, Irrigation and Livestock
MEW	Ministry of Energy and Water
NMSU	New Mexico State University
NVDA	Nangarhar Valley Development Authority
SIUC	Southern Illinois University Carbondale
UIUC	University of Illinois at Urbana-Champaign
US	United States
USAID	United States Agency for International Development
USDA	United States Department of Agriculture

¹ This distinction is important because the new Afghan Water Law passed this year (2010) gives responsibility for primary canals (diverted directly from the rivers) to the Ministry of Energy and Water (MEW), and for secondary canals (diverted from the primary canals to villages) and tertiary canals (diverted from the secondary canals for distribution to the farms) to be the responsibility of MAIL, specifically the newly established MAIL Department of Irrigation (DI). Similarly, the term “watercourse” is used interchangeably with the word “canal” in AWATT documents.

EXECUTIVE SUMMARY

An integrated crop-livestock production system is highly significant for the development of the Afghanistan agricultural sector and Afghanistan economy. Livestock feeding is one of the most expensive inputs in livestock production, and the introduction and development of improved forage crops and the establishment of forage seed production could provide many economic opportunities for small farmers in Afghanistan which would improve their livelihoods, and increase their profitability.

Increasing the capacity to achieve self-sufficiency in forage and seed production and producing seeds for future planting is the key to the sustainability and growth of the agricultural sector in Afghanistan. This is why one of the AWATT Program's major components and goals is the development of a cost-effective and sustainable forage and seed production system in Afghanistan.

During the period of 2009-2011, the AWATT Forage Technology Transfer Program initiated and established many different activities to build capacity for the production of a good quality seed, for multiplication, and certification of a seed with improved varieties and to meet the emergency seed requirements of Afghanistan. There have been several significant accomplishments to the AWATT Forage Program with the development of the Afghanistan seed production that can be summarized as follows:

- 20 forage irrigation, forage crop varietal comparison experiments and nitrogen fertilizer trials were applied in Balkh, Herat, Kabul and Nangarhar provinces;
- 601 forage demonstration plots were established in seven provinces in Afghanistan including Balkh, Herat, Kabul, Nangarhar, Parwan, Wardak and Logar provinces;
- 158 acres of farmer owned land have been cultivated and demonstrated by pearl millet (Shandawel-I open pollinated variety), new forage variety from Egypt, introduced by Dr. Hamdy Oushy, AWATT Forage Program Leader, to the Afghan farmers as the main summer forage crop;
- About 21,000 farmers, extension workers, faculty members, students and teachers have participated and trained in more than 600 forage demonstration plots at their owned farms, MAIL and DAIL Research Stations and College Farms on establishment and improved seed production technologies to build farmer's capacity in forage crop and seed production;
- 60.1 tons of Urea and DAP and 1,200 kg of pearl millet, cowpea and sudan grass seeds were provided by the AWATT Forage Program to 601 farmers for fertilizing and planting, for testing their the newly introduced forage crops at their demo plots, and for future seed multiplication;
- 429 MAIL extension workers in the seven provinces listed above received sufficient training in forage and seed production in addition to the large number of MAIL researchers who have received specialized training in forage applied research at MAIL Dehdadi, Shishem Bagh, Badam Bagh and Herat Agricultural Research Stations.

- Approximately 1.4 Metric Tons of pearl millet, cowpea and sudan grass foundation seed have been produced in cooperation with MAIL and AWATT at MAIL's Land in Kabul, Herat, and Balkh provinces in 2010;
- Capacity building in seed production and three forage germplasm of pearl millet, sudan grass and cowpea have been developed at the seed production sites at the MAIL and DAIL Research Stations in Balkh, Herat, Kabul, and Nangarhar provinces to produce, and maintain good quality and health standards starter seed material of the newly introduced improved forage varieties.

INTRODUCTION

The **AWATT Forage Technology Transfer Program** had been initiated in June of 2009 in five districts of Balkh province: Balkh, Dehdadi, Nahr-E-Shahi, Khulm and Chemtal and has been expanded in 2010 and 2011 to seven selected provinces: Balkh, Herat, Kabul, Logar, Nangarhar, Parwan, and Wardak. The major objectives of this program were to improve the traditional forage crop available for livestock production by introducing different forage crop varieties, from Egypt, that were better-adapted to the Afghan farmers' needs and local conditions; to ensure the sustainability of the transferred forage technology by establishing research and demonstration activities and forage foundation seed production sites; to demonstrate the benefits from using improved seeds to Afghan farmers and satisfy the farmers' needs for high quality and high yielding seeds in the different provinces of Afghanistan.



AWATT Forage Program Provincial Activities in Afghanistan through 2009-2011

AWATT FORAGE TECHNOLOGY TRANSFER PROGRAM RESEARCH AND DEMONSTRATION ACTIVITIES IN BALKH PROVINCE IN 2009 AND 2010

In June 2009, under the leadership of Dr. Hamdy Oushy, the AWATT Forage and Rangeland Specialist, the first forage demonstration, research and seed production sites for pearl millet (Shandawel-I open pollinated variety from Egypt), were established as newly introduced forage in Afghanistan at the MAIL Dehdadi Agricultural Research Station and the Agronomic Research Farm at Balkh University in Balkh Province.

In addition, on-farm forage demonstration activities were initiated in June 2009, by the AWATT Forage Technology Transfer Program and were established in five districts in Balkh Province in Afghanistan including Dehdadi, Chemtal, Nahr-e-Shahi, Khulm, and Balkh and at Dehdadi MAIL Research Stations.

Forage Applied Research Trials

According to the Afghan seed law, testing trials need to be performed in MAIL lands prior to registering and certifying any new plant variety for three seasons. Therefore, the AWATT forage program has initiated a series of testing trials for yield performance in comparison with the local and exotic forage summer crops since 2009 over the extended geographical areas in Afghanistan.

Experimental Trials at MAIL Dehdadi Agricultural Research Station

In the summer of 2009, three applied forage research trials were carried out by the AWATT Forage Program at MAIL Dehdadi Research Station in Dehdadi District, Balkh Province. These three research demonstrations included:

- Assessing the performance of the pearl millet forage crop under differing Nitrogen fertilizer regiments;
- Assessing the varietal performance of the newly introduced forage Pearl millet in comparison with the local forage Jawari (Yellow corn) and forage Sorghum/Sudan grass hybrid;
- Observing the pearl millet seed production performance characteristics under Balkh province environmental conditions.



Forage pearl millet research trials and seed production observing plots at the MAIL Dehdadi Research Station, Balkh Province in 2009

In order to achieve one of the major objectives of the AWATT Forage Program in Afghanistan, and to provide assessment and evaluation of yield performance and practical recommendations to the Afghanistan national and local government, extension workers, and the AWATT forage team provided forage data for statistical analysis, collected at the MAIL Dehdadi Research Station for each of the three applied forage research trials.



AWATT forage team and MAIL extension staff collecting forage data from demo plots at farmer owned properties

The First Comparison Experiment According to Afghan Seed Law: Forage Crops Varietal Comparison Trial

Experimental title: Forage yield performance of pearl millet (*Pennisetum glaucum*), sorghum/sudan grass hybrid and local Jawari (yellow corn) under MAIL-Dehdadi, Balkh Province conditions in Afghanistan.

Experimental objectives

- To evaluate the fresh and dry yield performance of Pearl millet in comparison with two forage crops under Dehdadi conditions;
- To recommend the best performing forage crop for Dehdadi environmental conditions in Balkh Province;
- To demonstrate the forage best agricultural practices and train MAIL-Researchers, Extensions, faculty and students in forage extension and varietal research;
- To produce a farmers' field guide for farmers and extension agents in Dari and Pashto about pearl millet's best agricultural practices.

Forage crops varietal comparison trial results

Table 1. Total dry forage yield (ton/ha) of the three tested forage crops as a percentage of the total accumulated yield obtained from three cuts at the MAIL-Dehdadi Research Station, Balkh Province in the summer growing season of 2009

Forage Crop	First Cut		Second Cut		Third Cut		Total of 3 cuts (MTon/ha)
	Dry Yield (MTon/ha)	% of the total	Dry Yield (MTon/ha)	% of the total	Dry Yield (MTon/ha)	% of the total	
Pearl Millet	3.65 ^A	38.31	2.92 ^A	30.71	2.95 ^A	30.98	9.52 ^A
Sorghum/sudan grass hybrid	3.08 ^A	60.26	1.48 ^B	28.88	0.56 ^B	10.85	5.12 ^B
Yellow Corn (Jawari)	3.66 ^A	100.00	0.00 ^C	0.00	0.00 ^B	0.00	3.66 ^B
CV (%):	16.67		39.65		55.97		19.94
LSD (0.05):	1.00		1.01		1.13		2.10
LSD (0.05): Pearl Millet	1.01						
LSD (0.05): Sorghum	1.54						

Figure 1. Dry forage yield (ton/ ha) distribution per cut of the tested three forage crops obtained from three cuts at MAIL-Dehdadi Research Station, Balkh Province in the summer growing season of 2009

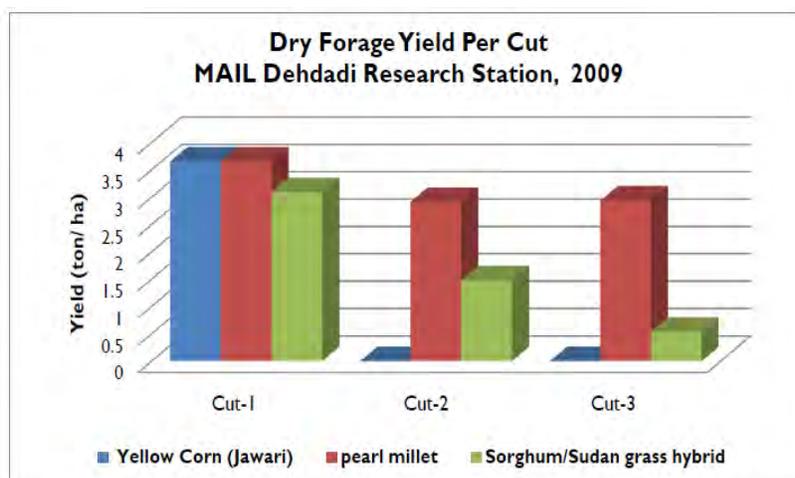
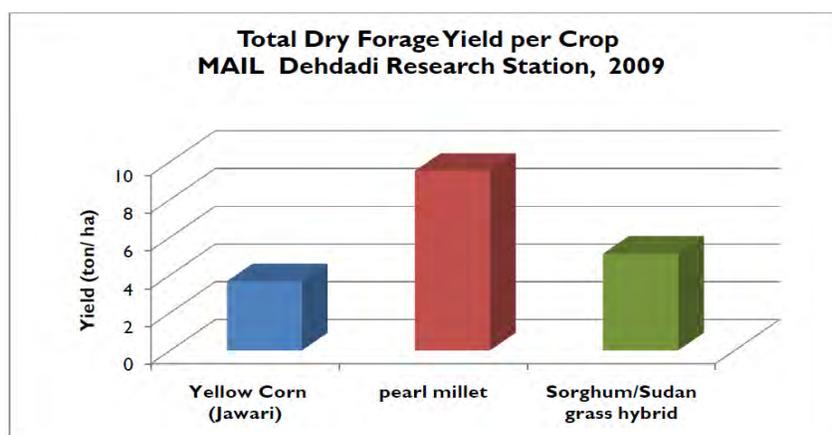


Figure 2. Total dry forage yield (ton/ha) distribution of the tested three forage crops obtained from three cuts at the MAIL-Dehdadi Research Station in Balkh in the summer growing season of 2009



Practical implementation

- Pearl millet (Shandawel-I variety from Egypt) introduced to Afghanistan by AWATT had the highest dry forage yield with 9.51 tons per hectare, which was 160 % greater than the Jawari and 86% greater than the Sorghum/Sudan grass hybrid (Mabrouk hybrid) from Egypt;
- Pearl millet also has a higher water use efficiency than the other crops, which makes it an excellent choice for Afghan growing conditions;

- Pearl millet proved its superiority as a potential high yielding and drought-resistant summer forage crop for Afghan farmers, herders and to the families with household livestock;
- Improved the capacity for MAIL researchers, extension, and Balkh University faculty and students on the applied forage research;
- Strengthen the national research base of MAIL and Universities;
- Strengthen the collaborations between MAIL and Universities on applied research and extension;
- Producing a field guide on forage best agricultural practices for MAIL, farmers and extension agents in Dari and Pashto;

Recommendations

- We do recommend registration, certification and multiplication of the proved introduced pearl millet by the MAIL-seed system in order to distribute it nationwide as a potentially high yielding forage, drought resistant and with a high nutritional value for Afghan farmers and herders.
- We do recommend MAIL to contract the National Seed Multiplication Enterprises to produce the certified seeds of pearl millet in order to be available for Afghan farmers and herders.

Experimental Trials at Agronomic Research Farm, Balkh University

The Second Comparison Experiment According to Afghan Seed Law: Forage Crops Varietal Comparison Trial

Experimental title: Forage yield performance of pearl millet (*Pennisetum glaucum*), sorghum/sudan grass hybrid and local Jawari (yellow corn) under Mazar-e-Sharif -Balkh University conditions in Afghanistan.

Experimental objectives

- To evaluate the yield performance of the three forage crops and select the superior one;
- To strengthen the applied research base, demonstrate and train MAIL-Researchers, Balkh University faculty members and students in forage applied research;
- To produce a farmers' field guide for farmers and extension agents in the local language Dari and Pashto

Forage crops varietal comparison trial results

Table 2. Total dry forage yield (ton/ ha) of the three tested forage crops as a percentage of the total accumulated yield obtained from three cuts at the College of Agriculture, Balkh University in the summer growing season of 2009

Forage Crop	First Cut		Second Cut		Third Cut		Fourth Cut		Total of 4 cuts (ton/ha)
	Dry Yield (ton/ha)	% of the total	Dry Yield (ton/ha)	% of the total	Dry Yield (ton/ha)	% of the total	Dry Yield (ton/ha)	% of the total	
Pearl Millet	12.87 ^A	24.23	18.41 ^A	34.65	13.13 ^A	24.71	8.72 ^A	16.41	53.13 ^A
Sorghum/sudan grass hybrid	11.66 ^B	27.34	15.59 ^B	36.57	8.10 ^B	18.99	7.29 ^A	17.10	42.64 ^B
Yellow Corn (Jawari)	9.68 ^C	100.00	0.00 ^C	0.00	0.00 ^C	0.00	0.00 ^B	0.00	9.68 ^C
CV (%):	2.45		12.99		22.84		20.68		8.44
LSD (0.05):	0.48		2.55		2.80		1.91		5.14
LSD (0.05): Pearl Millet	2.63								
LSD (0.05): Sorghum	2.88								

Pearl millet (Shandawel-I variety) had the highest fresh forage yield with 53.10 tons per hectare, which was 448.5 % greater than Jawari and 24.6 % greater than Sorghum/sudan grass hybrid (Mabrouk hybrid) from Egypt.

Figure 3. Fresh forage yield (ton/ha) distribution per cut of the tested three forage crops obtained from four cuts at the Agronomic Research Farm at College of Agriculture, Balkh University in the summer growing season of 2009

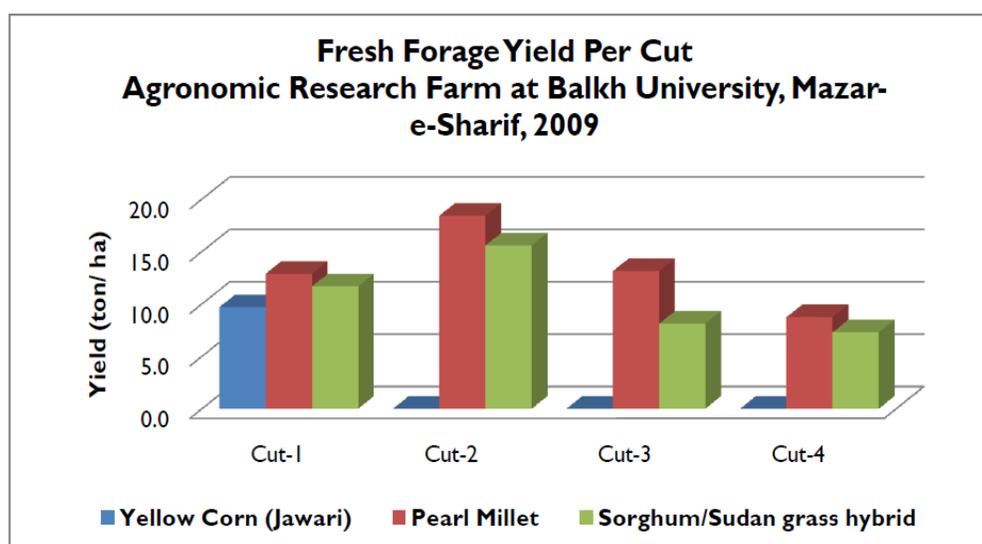
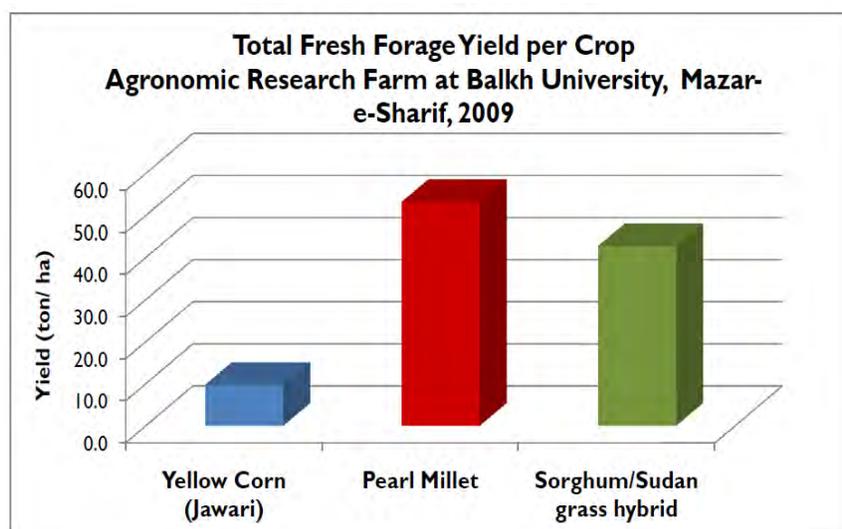


Figure 4. Total fresh forage yield (ton/ ha) of the tested three forage crops obtained from four cuts at the Agronomic Research Farm at the College of Agriculture, Balkh University in the summer growing season of 2009



Pearl Millet Evaluation at Farmer-Owned Land

In 2009, the AWATT Forage Program also tested and evaluated the introduced forage pearl millet (Shandawel-I variety from Egypt). Twenty nine forage on-farm demonstration plots at farmer-owned land were established in 500.00 m² plot each, by the AWATT Forage program, in the summer growing season of 2009, to test and evaluate the yield performance of the introduced pearl millet in comparison with the sorghum/sudan hybrid and the local forage Jawari (Yellow corn) at the farmer's level in collaboration with MAIL in five districts: Dehdadi, Chemtal, Nahr-e-Shahi, Khulm, and Balkh in Balkh Province.

The AWATT Forage technology transfer program has built significant public awareness among forage stakeholders in Balkh Province. For instance, the AWATT Forage Program contacted the largest livestock producers in Balkh District - the Kuchi farmers. These farmers were asked to be involved in the AWATT Forage Program Activities in Balkh Province 2009-2010, the demonstrated summer forage program. Three forage demo plots were established on **Kuchi** farmers' land in Balkh District.

Pearl Millet Forage Production

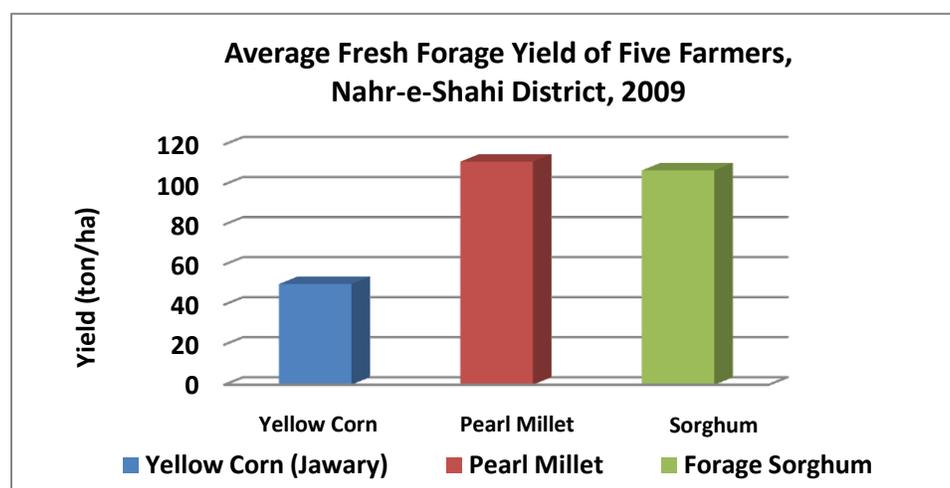
During the growing season of 2009, pearl millet, Jawari and sorghum/sudan grass hybrid forage data from multiple cuts were collected and computerized for a future analysis of yield performance on farmer-owned land. The collected forage data were evaluated at 29 farms in Dehdadi, Chemtal, Nahr-e-Shahi, Khulm, and Balkh districts in Balkh Province. The obtained results indicated that Pearl millet can produce a good yield of high quality dry matter. Pearl millet yields between 20 to 25 tons of fresh forage per *jerib* per growing season in Afghanistan.

The yield results obtained from 5 farms in Nahr-e-Shahi District, Balkh Province in the summer of 2009 and displayed below in Table (3) and Figure (5) showed that the pearl millet yield ranged between 58.8 – 150.2 tons per *hectare* and sorghum/sudan grass hybrid yield ranged between 70.1 – 137.8 tons per *hectare* from only three cuts. These results indicated that the pearl millet can yield up to 25 tons of fresh forage per *jerib* from only three cuts. Since, sorghum/sudan grass hybrid has been used in these trails as a performance comparison to pearl millet and Jawari; therefore, sorghum/sudan grass hybrid will not be considered as a recommended newly introduced high yielding forage crop for Afghanistan. This is partially because this forage crop is a hybrid, and farmers cannot produce their own seeds, farmers also cannot afford its price; in addition to sorghum/sudan grass hybrid seeds' low availability on the local market.

Table 3. Total fresh forage yield (ton/ha) of 5 demonstration plots and the combined yield of three tested forage crops obtained from three cuts at Nahr-e-Shahi District, Balkh Province in the summer growing season of 2009.

Forage Crop	Farmer#1 Abdul Raziq	Farmer#2 Amruddin Ghulam	Farmer#3 Abdul Bashir Ahmad	Farmer#4 Abdul Ghafar Khan	Farmer#5 Nasir Ahmad	Combined Analysis Average Fresh Forage Yield (ton/ha)
	Total Fresh Forage Yield (ton/ha)					
Pearl Millet	58.76 ^A	102.25 ^A	150.24 ^A	104.72 ^A	140.26 ^A	111.57 ^A
Sorghum/sudan grass hybrid	70.13 ^A	109.49 ^A	137.76 ^A	101.34 ^A	119.75 ^B	108.03 ^A
Yellow Corn (Jawari)	38.99 ^B	48.75 ^B	51.00 ^B	62.00 ^B	51.99 ^C	49.94 ^B
CV (%):	16.31	5.99	14.94	11.59	6.66	20.49
LSD (0.05):	15.79	8.99	29.21	23.48	11.98	12.11

Figure 5. Average of total fresh forage yield (ton/ha) of the tested three forage crops obtained from three cuts at 5 demonstration plots in Nahr-e-Shahi District, Balkh Province in the summer growing season of 2009



Forage Foundation Seed Production

In 2009, a seed production program for the forage pearl millet crop was established by the AWATT Forage Technology Transfer Program in parallel with the introduction of the crop to farmers through the on-farm demonstration plots and testing at MAIL Dehdadi Agricultural Research station in Balkh Province. 750 kg of pearl millet foundation seeds were produced in 2009 at two seed production sites.



Pearl millet produced under AWATT guidance

The AWATT Forage Program team established two large pearl millet seed production farm sites (5,000 and 5,169 m²) in Chemtal and Balkh districts, Balkh province. Two farmers were contracted to produce the Shandawel-I variety of pearl millet seed introduced from Egypt. The land preparation, fertilizer, plantation, and seed costs were paid for by AWATT.



Pearl millet foundation seed produced by AWATT delivered to Eng. Kateb Shams, DAIL-Balkh Director in 2010.

The training of farmers and MAIL extension workers on how to produce high quality fresh forage pearl millet is important. Sixty farmers have been trained in seed production of pearl millet and therefore, the AWATT Forage Program team has ensured the sustainability of the transferred forage technology as seed will continue to be produced beyond the AWATT

program. Thus, the collaborating farmers were able to save and plant their own pearl millet seeds in successive growing seasons.

Next Year Plan for the Produced 750 kg Pearl Millet Foundation Seeds

The produced in 2009 750 kg of pearl millet foundation seeds have been used for the next year forage pearl millet program in 2010. These seeds were used for 1) further seed multiplication to be sustained as a foundation seed, 2) more testing and evaluation at MAIL-research stations and universities in north, east, west, and central Afghanistan, 3) more demonstration plots (60 forage demo plots) at farmer-owned land in over 7 provinces.



AWATT Forage Pearl Millet Seed Production Training and Establishment Site at Plaz Posh Village, Balkh District, Balkh Province on July 3rd, 2009. 12 women farmers, 10 farmers, MAIL extension workers, researchers, students, and the AWATT Forage team attended the hands-on training and establishment.



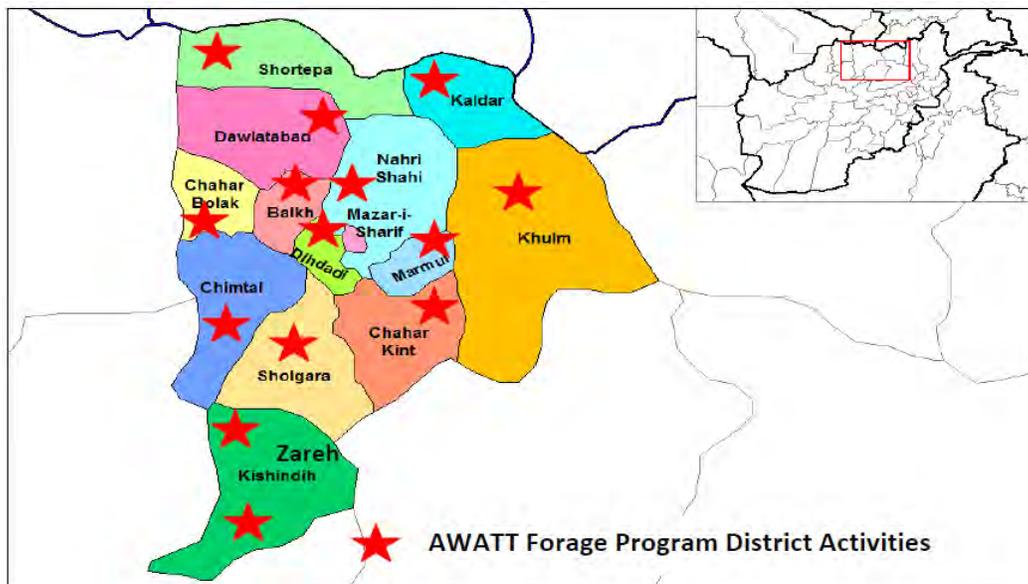
Farmers, MAIL extension workers and students were trained how to produce forage pearl millet seeds in furrows at Khulm and Balkh districts, Balkh Province in June 2009



MAIL extension workers, faculty and students were trained in forage and seed production of pearl millet at Khulm District and at the College of Agriculture, Balkh University in July 2009

The Second Season Pearl Millet Testing Trial in Balkh Province in 2010

Based on the promising results obtained in 2009, in 2010 the AWATT Forage Program the testing and evaluating process of the introduced forage pearl millet (Shandawel-I variety from Egypt). 141 forage on-farm demonstration plots were established to test and demonstrate pearl millet at farmer-owned land in 500.00 m² plot areas by the AWATT Forage program in the summer growing season of 2010 in 14 districts in Balkh province: Balkh, Char Bolak, Chemtal, Dehdadai, Shortepa, Kaldar, Sholgara, Nahri-Shahi, Khulm, Marmul, Dawlatabad, Zareh, Charkent, and Keshendi.



AWATT Forage Program District Activities in Balkh Province in 2010

Summary of Testing and Demonstrating Activities

- One hundred forty one forage demonstration plots have been implemented in the 14 districts, where 10 demonstration plots were established in each district in Balkh Province, 9.3 hectares of farmer-owned land were cultivated with pearl millet for testing and evaluating forage and seed production;
- One large scale forage demo plot (10 *jeribs* or 2 hectares) was established at the Kefayat Dairy Cattle Farm in Mazar-e-Sharif to introduce, test and demonstrate the pearl millet productivity, crop management and feeding system for milking cows.
- 10 *jeribs* (2 ha) of cultivated lands had been received by the AWATT Forage Program from MAIL-Balkh Province to continue the forage foundation of pearl millet seed production program. This program had been planned to secure a high quality forage foundation seed of pearl millet in addition to Sudan grass and the forage cowpea as newly introduced in 2010 forage crop to the MAIL seed system for the registration, certification and multiplication of seeds for Afghan farmers.
- The AWATT Forage Program team attended several meetings with the Balkh district administration to provide information about the program and the progress that was made. The AWATT program had received the full support of the Balkh district administration to continue the pearl millet foundation seed program, forage establishment and development program for the next year in order to alleviate livestock feeding problems for local farmers.
- The AWATT team with DAIL extension workers visited every farmer separately to evaluate the effect of pearl millet forage on their livestock and income. In addition, 14.5 tons of Urea and DAP and 200 kg of pearl millet seeds were provided by the AWATT Program to 141 farmers in order to establish their forage demo plots and produce their own pearl millet seeds for the next year of planting. The farmers paid 25% of the fertilizer costs and did all the agricultural practices at their farms.



AWATT team visited every farmer separately to evaluate the effect of pearl millet forage on their livestock and income

- Pearl millet seeds produced by farmers participating in the AWATT Forage Program had high germination percentages and a higher number of tillers than the mother seeds.



Some farmers participating in the AWATT Forage Program have already prepared the seeds produced in 2010 for the next season

- Farmers readily accepted the introduction of pearl millet and described it as the best forage crop, pointing to its high resistance to lodging (stalk breakage above ground level), multiple cutting (four cuts), high nutritional value in which their milk production was significantly increased as well as their animals weight gains. Farmers expressed their willingness to replace the local Jawari (Yellow corn) with pearl millet.
- The AWATT Forage team has been asked by a large number of farmers (150 of 300 farmers) to provide the pearl millet seeds for the next year, and they are ready to buy the seeds at the price of 100Afs/Kg.
- Demonstration and testing of the pearl millet productivity, crop management and the feeding system for milking cows was established at the Kefayat Dairy Cattle Farm, Mazar-e-Sharif in Balkh District in one large-scale (10 *jeribs* – 2 hectares) forage demo plot.

Pearl Millet Forage Yield Performance Results

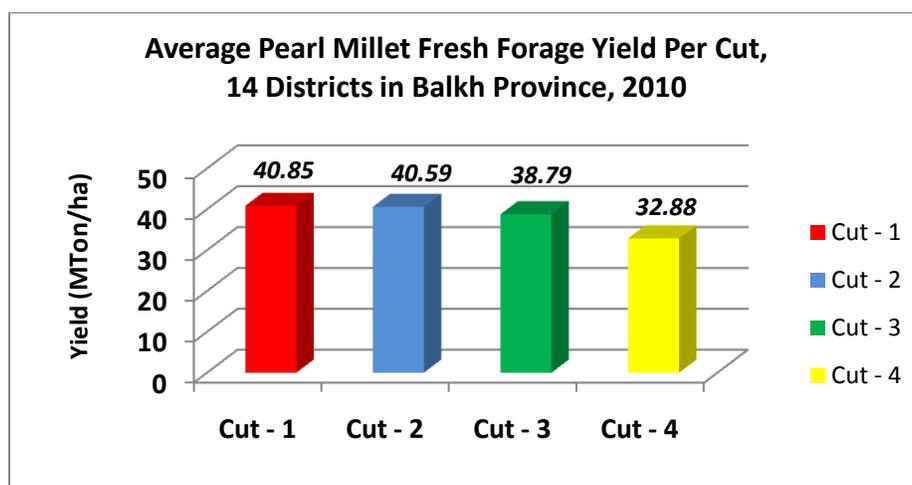
The AWATT Forage Program team prepared layouts of 141 demonstration plots in 14 districts and forage demonstration plots at the Kefayat Dairy Cattle Farm in Mazar-e-Sharif. Forage data from four cuts at the farmers' demo plots and five cuts at the Kefayat Dairy Cattle Farm demo plots were collected by the MAIL extension workers and AWATT Forage team and analyzed for a future evaluation of yield performance on farmer-owned land.

The forage pearl millet yield results obtained in 2010 at 133 demonstration plots (farms) in Balkh province are displayed below in Table (4) and Figure (6).

Table 4. Average fresh forage yield of pearl millet obtained in 14 Districts in Balkh Province at 133 demonstration plots (farms) in the summer growing season of 2010

SN	District Name	Number of Farmers	Average Fresh Forage Yield per Cut (MTon/ha)				Total Fresh Forage Yield (MTon/ha)
			Cut - 1	Cut - 2	Cut - 3	Cut - 4	
1	Balkh	7	46.31	35.43	42.38	38.99	163.11
2	Char Bolack	9	43.13	44.76	39.04	35.64	162.56
3	Char Kent	10	38.15	38.94	36.53	33.11	146.73
4	Chemtal	10	37.68	41.90	37.47	30.98	148.03
5	Dawlat Abad	9	43.80	39.54	38.35	31.77	153.46
6	Dehdadi	9	41.11	39.19	35.56	34.58	150.43
7	Kaldar	9	38.43	39.15	38.71	32.57	148.86
8	Khulm	10	34.66	38.53	38.24	31.52	142.95
9	Kishindi	10	45.32	45.79	40.33	32.40	163.84
10	Marmul	10	38.83	38.52	37.98	31.42	146.75
11	Nahr-e-Shahi	10	40.82	43.96	39.85	32.57	157.20
12	Shortapa	10	47.04	46.26	41.30	34.21	168.81
13	Shoulgara	10	37.74	39.84	43.03	33.46	154.08
14	Zari	10	38.88	36.46	34.28	27.17	136.79
Average of Fresh Forage Yield (MTon/ha)	14	133	40.85	40.59	38.79	32.88	153.11

Figure 6. Average of fresh forage yield (MTon/ha) of pearl millet obtained from four cuts at 133 demonstration plots in 14 Districts in Balkh Province in the summer growing season of 2010

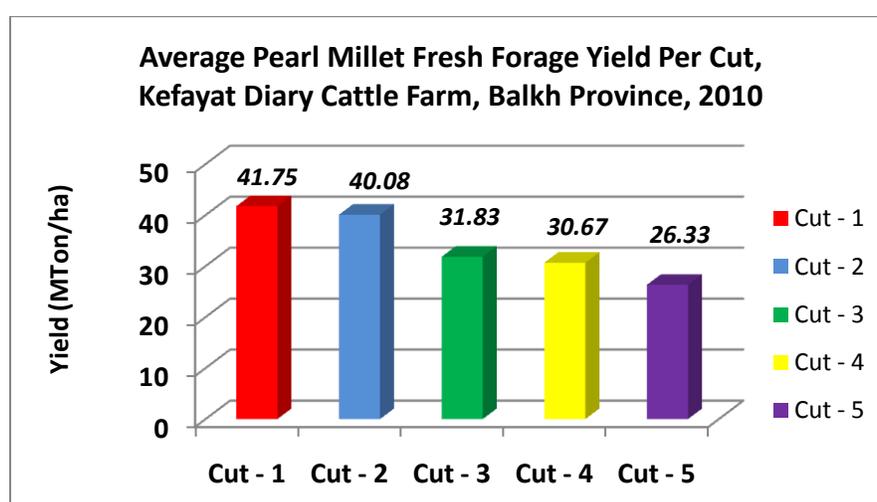


The forage pearl millet yield results obtained in 2010 at the Kefayat Dairy Cattle Farm in Mazar-e-Sharif demonstration plot in Balkh province are displayed below in Table (5) and Figure (7).

Table 5. Fresh forage yield of pearl millet obtained from 5 cuts at the Kefayat Dairy Cattle Farm demonstration plot in Balkh Province in the summer growing season of 2010

Farmer Name	Crop	Village	Fresh Forage Yield per Cut (MTon/ha)					Total Fresh Forage Yield (MTon/ha)
			Cut - 1	Cut - 2	Cut - 3	Cut - 4	Cut - 5	
Abdul Salam Khan	Pearl Millet	Kefayat Dairy Cattle Farm	41.75	40.08	31.83	30.67	26.33	170.67

Figure 7. Average of fresh forage yield (MTon/ha) of pearl millet obtained from five cuts at Kefayat Dairy Cattle Farm demonstration plot in Balkh Province in the summer growing season of 2010



Summary of results

- The forage pearl millet yield ranged from 4-5 cuts per summer growing season.
- The pearl millet fresh forage yield ranged from 136.8 – 170.7 MTon/ha per growing season.
- The overall average fresh forage yield of pearl millet over 14 districts for cut 1, 2, 3, 4 were 40.9, 40.6, 38.8, 32.9 MTon/ha per growing season of 2010.
- In comparison with the only local existing traditional summer forage crop Jawari (local yellow corn), pearl millet proved superiority and produces three times as much fresh yield (153.1 MTon/ha) as Jawari (50 MTon/ha per season).
- The participating 141 farmers reported that they will replace Jawari with pearl millet after they planted at their farms, tested, fed to their livestock, and increased milk production and weight gain of their livestock.
- The participating 41 farmers requested that MAIL has to produce the pearl millet seeds for all Afghan farmers and make it available in their local seed markets; in addition, they expressed their willingness to purchase the pearl millet seed for 100 Afs/Kg.

Recommendations

- Based on the results and findings documented above, we recommend that this adapted, promising, high yielding, high nutritional and long growing season forage pearl millet crop be registered and certified at MAIL Seed System as a new forage crop for the benefits of the Afghan farmers, herders, dairy productions and for agricultural production enhancement in Afghanistan.
- National Afghan seed enterprises should include the forage pearl millet as the first forage crops to be produced according to the new seed law of Afghanistan.

Forage Foundation Seed Production in Balkh Province in 2010

Ten jeribs (two hectares) at MAIL-Balkh Agricultural Land (MBAL) in Balkh District, Balkh Province were used in the summer growing season of 2010 to produce foundation seeds for pearl millet, sudan grass, and cowpea. The land was provided to the AWATT Forage Program by MAIL in June 2010 to initiate the forage foundation seed production. The produced forage seeds will be delivered to MAIL-Seed System in order to register and certified according to the Afghan seed law. Further testing might be necessary at MAIL research station for cowpea and sudan grass before registration and certification.

During the planting period in 2010, the ten jerib seed production site had been prepared and planted: six jeribs –with pearl millet, three jeribs – sudan grass and one jerib – cowpea.

During the 2010 growing season the following forage foundation seeds were produced at DAIL/Balkh in Balkh District: pearl millet - 543.0 kg, sudan grass - 136.0 kg, cowpea -32.0 kg.

AWATT FORAGE TECHNOLOGY TRANSFER PROGRAM FORAGE DEMONSTRATION PLOTS AND SEED TESTING IN 2010

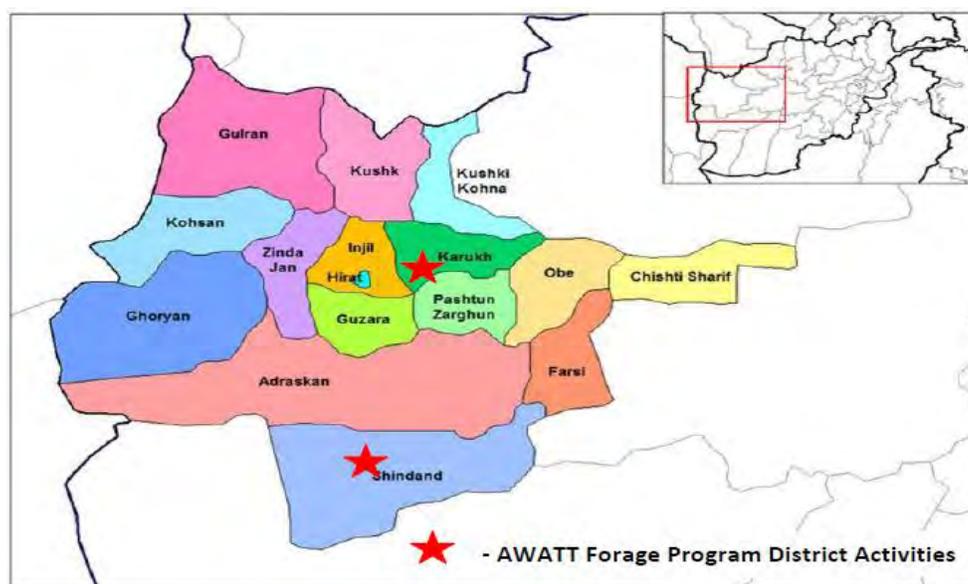
In 2010, under the leadership of Dr. Hamdy Oushy, the AWATT Forage and Rangeland Specialist, the AWATT Forage Technology Transfer Program research and demonstration activities were expanded and developed in seven provinces in Afghanistan: Herat, Balkh, Parwan, Nangarhar, Kabul, Logar and Wardak. During the 2010 growing season, the AWATT Forage program established 17 applied forage experiments and 542 forage demonstration plots in collaboration with MAIL and DAIL research and extension systems including:

- 10 experimental plots and 71 demo plots in Herat province ;

- 1 experimental plot and 141 demo plots in Balkh province;
- 250 demo plots in Parwan province;
- 2 experimental plots and 41 demo plots in Nangarhar province;
- 5 experimental plots and 19 demo plots in Kabul province;
- 10 demo plots in Logar province
- 10 demo plots in Wardak province.

HERAT PROVINCE

Ten experimental plots for forage and seed production testing were established at MAIL Herat Agricultural Research Station (5) and the College of Agriculture Agronomic Research Farm, Herat University (5); and seventy one forage demonstration plots were developed in Shindand (21) and Enjil districts (50) in Herat Province in summer season 2010.



AWATT Forage Program District Activities in Herat Province in 2010

Forage Applied Research Trials

MAIL-Herat Agricultural Research Station (MHARS) in Enjil District

Five applied forage research trials in four Jeribs and forage foundation seed production sites in sixteen Jeribs have been carried out by the AWATT Forage Program at MAIL-Herat Agricultural Research Station (MHARS) in Enjil District with a total of twenty Jeribs (10 acres) of land as follows:

- Two fertilizer experiments on pearl millet and sudan grass;

- Forage varietal comparison experiment with pearl millet, sudan grass and Jawari, a local forage crop;
- Forage mixture experiments with cowpea/pearl millet, cowpea/sudan grass, and cowpea/Jawari;
- Forage crop foundation seed production demonstration plots of pearl millet, sudan grass and cowpea.

Collected forage data were evaluated by the AWATT Forage Technology Transfer team and, the yield results obtained in 2010 are introduced below.

Forage Crops Varietal Comparison Trial

Experimental title: Forage yield performance of pearl millet (*Pennisetum glaucum*), sudan grass and local Jawari (yellow corn) under MHARS, Herat province environmental conditions in Afghanistan on 2010.

Experimental objectives

- To evaluate the fresh yield of the three forage crops under MHARS, Herat province conditions;
- To recommend the best performing forage crop for MHARS type conditions in Herat Province;
- To demonstrate the best forage practices and train MAIL-Researchers, faculty and students in forage varietal research;
- To produce a farmers' field guide for farmers and extension agents in the local languages of Dari and Pashto about pearl millet's best agricultural practices.

Forage crops varietal comparison trial results

Table 6. Total Fresh forage yield (MTon/ha) of the three tested forage crops as a percentage of the total accumulated yield obtained from two cuts at MAIL Herat Agricultural Research Station, Herat Province in the summer growing season of 2010

Forage Crop	First Cut		Second Cut		Total of 2 cuts (MTon/ha)
	Yield (MTon/ha)	% of the total	Yield (MTon/ha)	% of the total	
Sudan Grass	26.00 ^A	48.44	27.67 ^A	51.56	53.67 ^A
Pearl Millet	26.67 ^A	48.78	28.00 ^A	51.22	54.67 ^A
Yellow Corn (Jawari)	26.80 ^A	100.00	0.00 ^B	0.00	26.80 ^B
CV (%)	17.40		23.18		19.27
LSD (0.05)	10.45		9.75		19.68
LSD (0.05) Sudan Grass	8.23				
LSD (0.05) Pearl Millet	14.42				

Note: Due to late plantation, on July 2010, in this experiment only two cuts have been obtained.

Figure 8. Fresh forage yield (MTon/ha) distribution per cut of the tested three forage crops obtained from two cuts at MAIL Herat Agricultural Research Station, Herat Province in the summer growing season of 2010

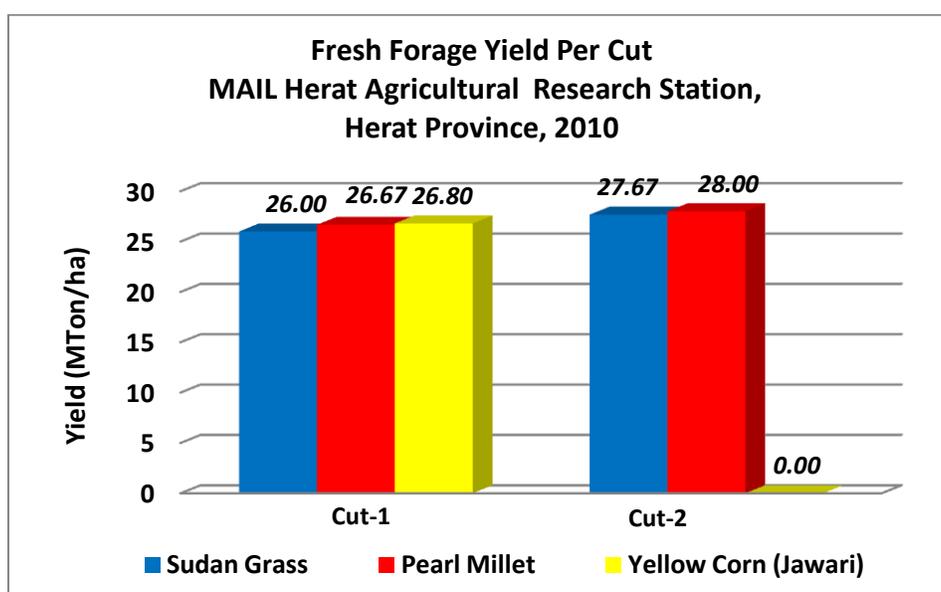
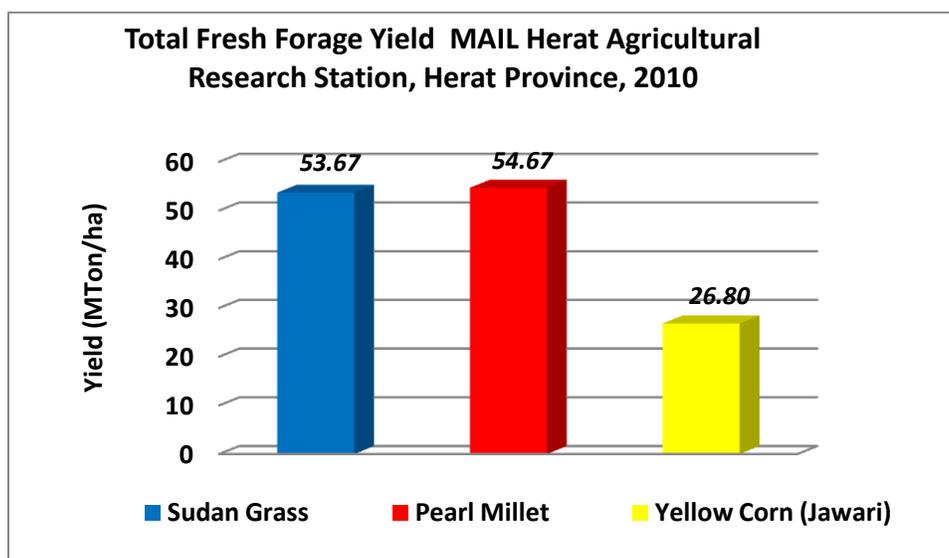


Figure 9. Total fresh forage yield (MTon/ ha) distribution of the tested three forage crops obtained from two cuts at MAIL Herat Agricultural Research Station, Herat Province in the summer growing season of 2010



Summary of results

- Due to late plantation, on July 2010, in this experiment the forage pearl millet yield have been obtained from two cuts only.
- The total fresh forage yields from two cuts were 54.7, 53.7, and 26.8 MTon/ha for pearl millet, sudan grass and Jawari per growing season respectively.

- In comparison with the only local existing traditional summer forage crop Jawari (local yellow corn), pearl millet proved superior and produces two times as much fresh yield (54.7 MTon/ha) as Jawari (26.8 MTon/ha per season).
- The participating 71 farmers reported that they will replace Jawari with pearl millet after plantation at their farms, testing, feeding their livestock, increasing their milk and weight gain of their livestock.
- The participating 71 farmers requested that MAIL has to produce the pearl millet seeds for all Afghan farmers, making it available in their local seed markets; in addition, they expressed their willingness to purchase the pearl millet seed for 100 Afs/Kg.

Recommendations

- Based on the results and findings documented above, we recommend that this adapted, promising, high yielding, highly nutritional and long growing season forage pearl millet crop to be registered and certified at MAIL Seed System as a new forage crop for the benefit of the Afghan farmers, herders, dairy productions and for the agricultural production enhancement in Afghanistan.
- National Afghan seed enterprises should include the forage pearl millet as the first forage crops to be produced according to the new seed law of Afghanistan.

On Farm Demonstration Plots

Fourteen acres of farmer-owned land were cultivated by pearl millet for forage and seed production in Enjil and Shindand districts under the supervision of the AWATT Forage team and DAIL-extensions.

Seven tons of Urea and DAP and 90 kg of pearl millet seeds were provided by the AWATT Forage Program to seventy one farmers in order to fertilize and plant their forage demo plots. Every farmer received two 50 kg bags of Urea and DAP; the farmers paid 25% of the fertilizer costs and did all the agricultural practices at their farms.



Hand-on training was provided through forage demo plots by the AWATT Forage Program to farmers

During the 2010 growing season, the AWATT Forage Program team worked closely with the DAIL extension workers to build their capacity and provide guidance on how they could perform their work effectively during pearl millet forage and seed production stages.

On-Farm Demonstration Results

- During the summer of 2010, farmers in Shindand district made the first cutting of their pearl millet forage in the middle of August, and the second cutting in the middle of September. Farmers reported both good growth of pearl millet and satisfaction with the impact on their animals.
- Ab Ghafoor Khan, the MAIL director of extension activities in the Shindand district, researched the effects of the newly introduced pearl millet forage by directly observing a cow for 12 days. He recorded a daily increase of two kg of milk;
- The pearl millet crop survey in Shindand showed that the average pearl millet production is 3.3 kg /m² (6,600 kg per *jerib*) per cut.

Similar activities have been conducted by the AWATT Forage team in Enjil District:

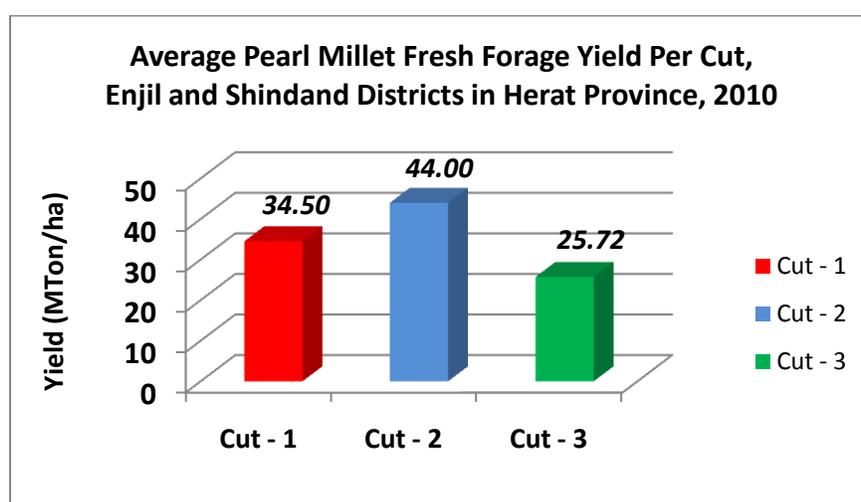
- In July-August 2010, the AWATT Forage team monitored the effect of various forage varieties on livestock, in this case dairy cattle milk production. Three cows were quarantined and observed for a ten-day period in two villages to demonstrate the effect of the newly-introduced forage.
- With AWATT's guidance and supervision, the farmers were trained to observe and collect the research data (Mullah Jayllan and Mohammmd Nahiam from Frashan village and Gull Ahamad from Qafslan village) during the feeding of pearl millet forage to cows.
- The farmers reported daily on milk production increases during the experiment. The average increase in milk production from cows switching forage to pearl millet was 4kg/daily and the average increase in milk fat production was 1.76gram/daily from a single pearl millet-fed cow;
- By switching forage to pearl millet, farmers with dairy cows can increase their daily income, by 48Afs (2.4kg x 20/Afs) per cow for milk and 24.6 Afs (1.76gramx14Afs) per cow for cream (milk fat), for a total potential increase in income of 72.6 Afs per day from each cow (additional 2,178 Afs per month).

In the growing season of 2010, pearl millet forage data from 18 randomly selected in Enjil (9), and Shindand (9) districts farms have been collected and analyzed. The obtained yield results are displayed below in Table (7) and Figure (10).

Table 7. Average fresh forage yield of pearl millet (MTon/ha) obtained from two Districts in Herat Province at randomly selected 18 demonstration plots (farms) in the summer growing season of 2010

SN	District Name	Number of Farmers	Average Fresh Forage Yield per Cut (MTon/ha)			Total Fresh Forage Yield (MTon/ha)
			Cut - 1	Cut - 2	Cut - 3	
1	Enjil	9	36.00	43.00	24.13	103.13
2	Shindand	9	33.00	45.00	27.30	105.30
Average of Fresh Forage Yield (MTon/ha)	2	18	34.50	44.00	25.72	104.22

Figure 10. Average of fresh forage yield (MTon/ha) of pearl millet per cut obtained at 18 randomly selected demonstration plots in 2 Districts in Parwan Province in the summer growing season of 2010



Summary of results

- The obtained number of cuts was three cuts per summer growing season that was partly due to late plantation on July, 2010.
- The pearl millet fresh forage yield ranged from 103.0 – 105.0 MTon/ha per growing season from three cuts.
- The overall average fresh forage yield of pearl millet over two districts per cut 1, 2, and 3 were 34.5, 44.0, and 25.72 MTon/ha per growing season of 2010.
- The participated 71 farmers reported that they will replace Jawari by pearl millet after they planted at their farms, tested, fed to their livestock, increased milk production and their livestock gained weight.
- The participating 71 farmers requested that MAIL has to produce the pearl millet seeds for all Afghan farmers, make it available in their local seed markets; in addition, they expressed their willingness to purchase the pearl millet seed for 100 Afs/Kg.

Recommendations

- Based on the results and findings documented above, we recommend that this adapted, promising, high yielding, highly nutritional and long growing season forage pearl millet crop to be registered and certified at MAIL Seed System as a new forage crop for the benefits of the Afghan farmers, herders, dairy productions and for the agricultural production enhancement in Afghanistan.
- National Afghan seed enterprises should include the forage pearl millet as the first forage crops to be produced according to the new seed law of Afghanistan.

Forage Foundation Seed Production

Sixteen Jeribs (3.2 hectares) at MAIL-Herat Agricultural Research Station in Enjil district, Herat province were used in the summer growing season of 2010 to produce foundation seeds for pearl millet, sudan grass, cowpea. The land was provided to the AWATT Forage Program by MAIL in June 2010 to initiate the forage foundation seed production.

The produced forage seeds will be delivered to MAIL-Seed System in order to be registered and certified according to the Afghan seed law.

During the planting period in 2010, the 16 Jeribs seed production site had been prepared and planted: 7 Jeribs –with pearl millet, 7 Jeribs – sudan grass and 2 Jeribs – cowpea.

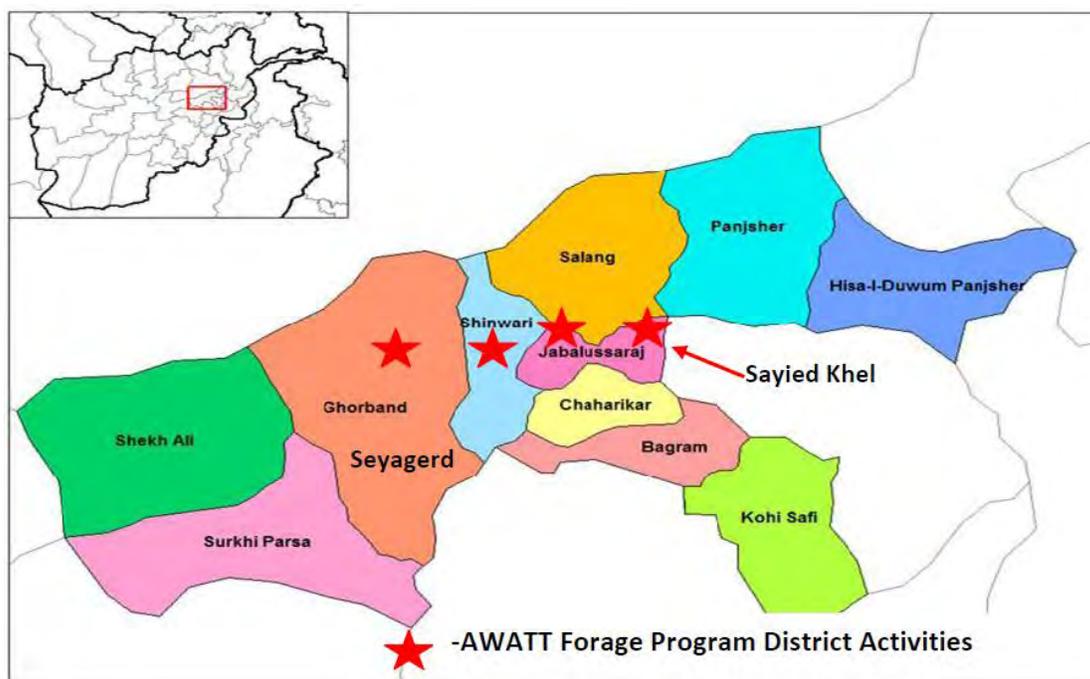
During the 2010 growing season, the following forage foundation seeds were produced at MAIL/Herat Agricultural Research Station in Enjil district: pearl millet - 125.0 kg, sudan grass - 120.0 kg, cowpea - 70.0 kg.

PARWAN PROVINCE

At the request of the PRT in Parwan Province, the AWATT Forage Program has initiated activities in five districts of the Parwan province: Jabal Seraaj, Seyagerd, Sayied Khel, Central Parwan, and Shenwari.

On Farm Demonstration Plots

During the 2010 growing season, Dr. Hamdy Oushy, the AWATT Forage & Rangeland Specialist, and the AWATT Forage Program team worked on the development and supervision of 250 forage demonstration plots (64 *jeribs* – 13 hectares) that have been established and planted in districts in Parwan Province for the purpose of evaluating and demonstrating pearl millet forage to local farmers in Parwan province.



AWATT Forage Program District Activities in Parwan Province in 2010

Pearl Millet Forage Yield Performance Results

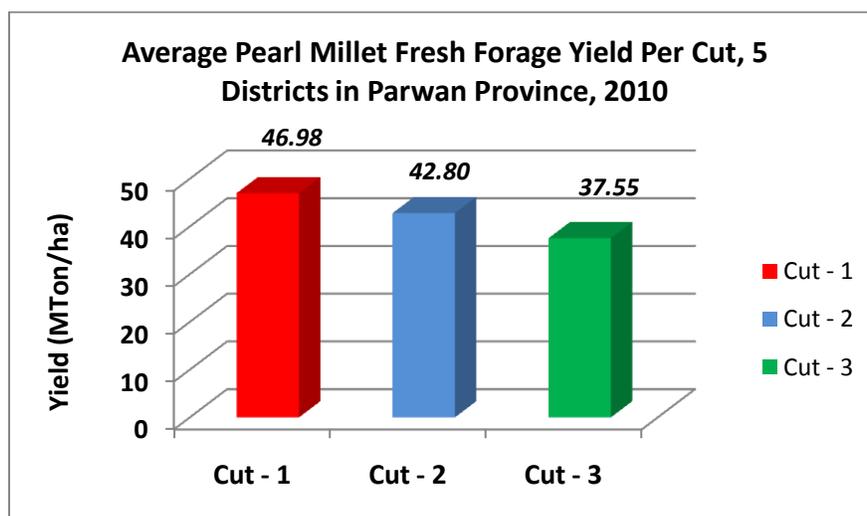
The AWATT Forage Program team prepared layouts of 230 pearl millet forage demonstration plots in 5 districts in Parwan province. Forage data from three cuts at the farmers' demo plots have been collected by the MAIL extension workers and AWATT Forage team and analyzed for a future evaluation of yield performance on farmer-owned land.

The forage pearl millet yield results obtained in 2010 at the 230 demonstration plots (farms) in Parwan province are displayed below in Table (8) and Figure (11). Due to heavy flooding, 20 demonstration plots (farmers') have been excluded from evaluation of pearl millet forage yield performance on farmer-owned land.

Table 8. Average fresh forage yield of pearl millet obtained in five Districts in Parwan Province at 230 demonstration plots (farms) in the summer growing season of 2010

NN	District Name	Number of Farmers	Average Fresh Forage Yield per Cut (MTon/ha)			Total Fresh Forage Yield (MTon/ha)
			Cut - 1	Cut - 2	Cut - 3	
1	Shenwari	41	36.21	33.87	29.83	99.91
2	Seia Gerd	39	41.88	38.22	33.70	113.80
3	Central Parwan	50	48.15	42.30	36.35	126.80
4	Jabal Saraj	50	50.61	45.54	39.75	135.90
5	Sayeed Khail	50	58.06	54.06	48.10	160.22
Average of Fresh Forage Yield (MTon/ha)		230	46.98	42.80	37.55	127.33

Figure 11. Average of fresh forage yield (MTon/ha) of pearl millet obtained from three cuts at 230 demonstration plots in 5 Districts in Parwan Province in the summer growing season of 2010



Summary of results

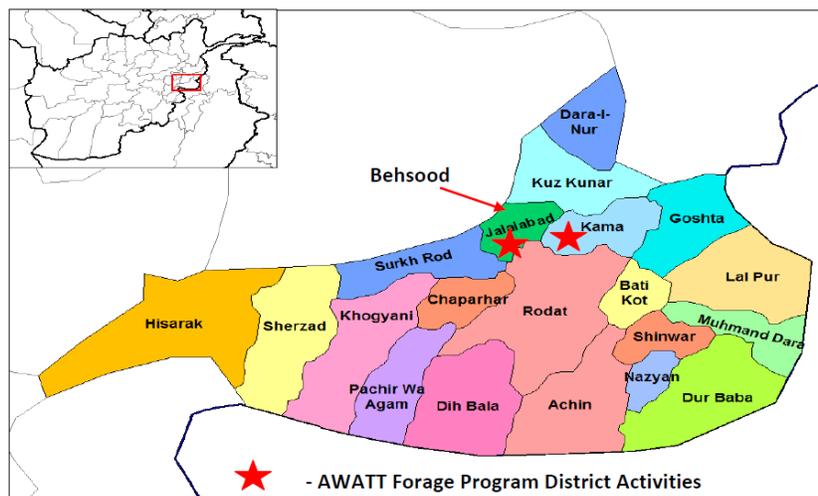
- The forage pearl millet yield has been obtained from 3 cuts only during the summer growing season of 2010 due to the late plantation on July, 2010.
- The pearl millet fresh forage yield per growing season ranged from 99.9 – 160.2 MTon/ha.
- The overall average fresh forage yields of pearl millet over 5 districts during growing season of 2010 for cut 1, 2, and 3 were 47.0, 42.8, and 37.6 MTon/ha respectively.
- The participating 250 farmers reported that they will replace Jawari by pearl millet after they planted at their farms, tested, fed to their livestock, increased milk production and their livestock weight gain.
- The participating 250 farmers requested that MAIL has to produce the pearl millet seeds for all Afghan farmers, make it available in their local seed markets; in addition, they expressed their willingness to purchase the pearl millet seed for 100 Afs/Kg.

Recommendations

- Based on the results and findings documented above, we recommend that this adapted, promising, high yielding, highly nutritional and long growing season forage pearl millet crop be registered and certified at MAIL Seed System as a new forage crop for the benefits of the Afghan farmers, herders, dairy productions and for the agricultural production enhancement in Afghanistan.
- National Afghan seed enterprises should include the forage pearl millet as the first forage crops to be produced according to the new seed law of Afghanistan.

NANGARHAR PROVINCE

In June 2010, the AWATT Forage Program had initiated its activities on pearl millet forage and seed production technological demonstration and testing in two districts of the Nangarhar province: Kama and Behsood. Twenty farmers in two districts (10 farmers in each district) were selected to participate in the pearl millet on-farm demonstration and testing program.



AWATT Forage Program District Activities in Nangarhar Province in 2010

On Farm Demonstration Plots

During the 2010 growing season, Dr. Hamdy Oushy, the AWATT Forage & Rangeland Specialist, and the AWATT Forage Program Team Leader worked on the development and supervision of 20 pearl millet forage demonstration plots (6 *jeribs* – 1.2 hectares) that have been established and planted in two districts in Nangarhar Province for the purpose of pearl millet forage and seed production testing and demonstration to local farmers:

- The AWATT Forage Program Team and DAIL worked closely with the farmers in both districts to monitor their progress and provide guidance and necessary technical assistance. The AWATT Forage team worked closely with the DAIL extension workers to guide them and improve their capacity to perform their work effectively;
- All the demonstration plots were regularly visited by the AWATT Forage team and the DAIL extension workers;

Pearl Millet Forage Yield Performance Results

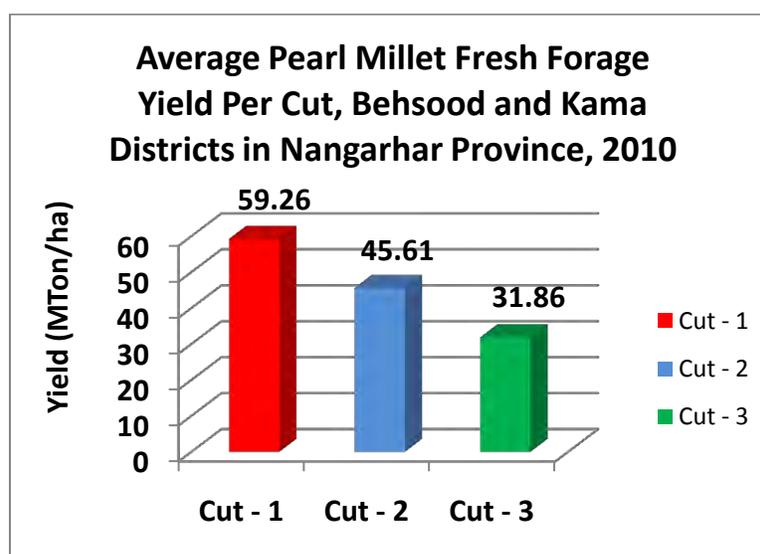
In June of 2010, the AWATT Forage Program team prepared layouts of 20 pearl millet forage demonstration plots in Kama and Behsood districts in Nangarhar province. Forage data from three cuts at the farmers' demo plots have been collected by the MAIL extension workers and the AWATT Forage team and analyzed for a future evaluation of yield performance on farmer-owned land.

The forage pearl millet yield results obtained in 2010 at 17 demonstration plots (farms) in Nangarhar province are displayed below in Table (9) and Figure (12). Due to heavy flooding, 3 demonstration plots (farmers) have been excluded from evaluation of pearl millet forage yield performance on farmer-owned land in Nangarhar province.

Table 9. Average fresh forage yield of pearl millet obtained in 2 Districts in Nangarhar Province at 17 demonstration plots (farms) in the summer growing season of 2010

NN	District Name	Number of Farmers	Average Fresh Forage Yield per Cut (MTon/ha)			Total Fresh Forage Yield (MTon/ha)
			Cut - 1	Cut - 2	Cut - 3	
1	Behsood	3	56.52	57.50	51.67	165.69
2	Kama	10	62.00	33.73	12.05	107.78
Average of Fresh Forage Yield (MTon/ha)		13	59.26	45.61	31.86	136.73

Figure 12 Average of fresh forage yield (MTon/ha) of pearl millet obtained from three cuts at 17 demonstration plots in 2 Districts in Nangarhar Province in the summer growing season of 2010



Summary of results

- During the summer growing season of 2010, the obtained number of cuts was three cuts that was partly due to the late plantation in July, 2010.
- The pearl millet fresh forage yield per growing season from three cuts ranged from 107.8 MTon/ha in Behsood and 165.7 MTon/ha in Kama districts.
- The overall average fresh forage yield of pearl millet per growing season of 2010 in two districts per cut 1, 2, and 3 were 59.3, 45.6, and 31.9 MTon/ha respectively.

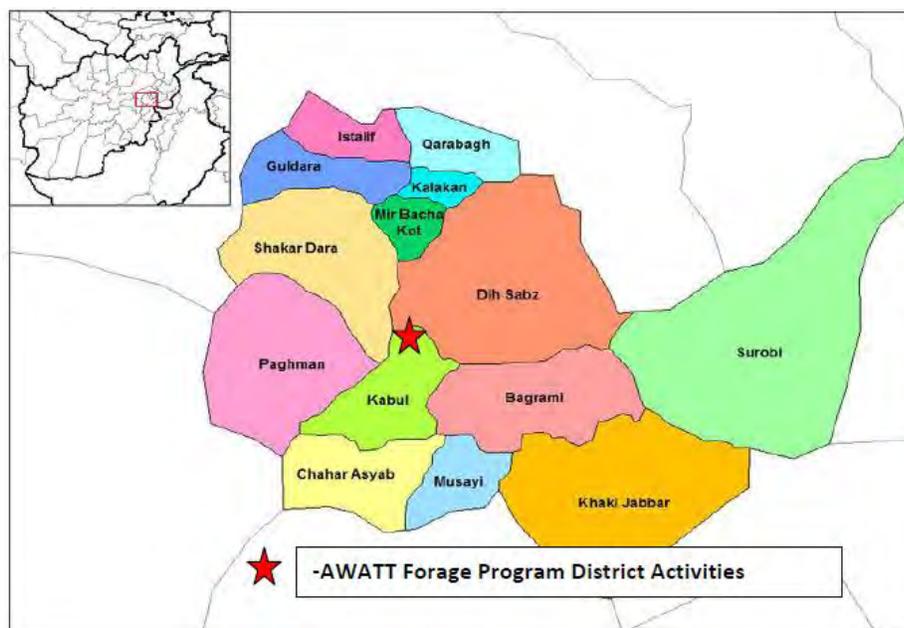
- The participating 20 farmers reported that they will replace Jawari by Pearl millet after they planted at their farms, tested, fed to their livestock, increased milk production and their livestock weight gain.
- The participating 20 farmers requested that MAIL has to produce the pearl millet seeds for all Afghan farmers, make it available in their local seed markets; in addition, they expressed their willingness to purchase the pearl millet seed for 100 Afs/Kg.

Recommendations

- Based on the results and findings documented above, we recommend that this adapted, promising, high yielding, highly nutritional and long growing season forage pearl millet crop be registered and certified at MAIL Seed System as a new forage crop for the benefit of the Afghan farmers, herders, dairy productions and for the agricultural production enhancement in Afghanistan.
- National Afghan seed enterprises should include the forage pearl millet as the first forage crops to be produced according to the new seed law of Afghanistan.

KABUL PROVINCE

In the 2010 growing season, the AWATT Forage Program established four applied forage research trials at MAIL Badam-Bagh Research Farm and Agronomic Research Farm at the College of Agriculture, Kabul University.



AWATT Forage Program District Activities in Kabul Province in 2010

Forage Applied Research Trials

Experimental Trial at Agronomic Research Farm, Kabul University

In June 2010, the AWATT Forage Program established applied forage research and demonstration programs at the Agronomic Research Farm, College of Agriculture, Kabul University.

Two applied forage research trials were carried out in cooperation with the College Dean, faculty members, and students at the Agronomic Research Farm on 4000 m²:

- Irrigation experiment to determine a proper irrigation schedule for sudan grass;
- Forage crop varietal comparison experiment for pearl millet, sudan grass, cowpea, sorghum and local forage Jawari.

Forage Crops Varietal Comparison Trial

Experimental title: Forage yield performance of pearl millet, sorghum/Sudan grass hybrid, cowpea, Sudan grass and local Jawari (yellow corn) with the Agronomic Research Farm, Kabul University, and under Kabul Province conditions in Afghanistan.

Experimental objectives

- To evaluate the fresh yield of the five forage crops at the Agronomic Research Farm under Kabul University conditions;
- To recommend the best performing forage crop for the Agronomic Research Farm under Kabul University type conditions in Kabul Province;
- To demonstrate and train faculty members and students in forage applied research;

Forage crops varietal comparison trial results

The results for fresh forage yield of five different summer forage crops: pearl millet, sudan grass, cowpea, sorghum, and local yellow corn (Jawari) obtained at the College of Agriculture, Kabul University in the summer growing season of 2010 are displayed in Table (10 and 11) and Figure (13).

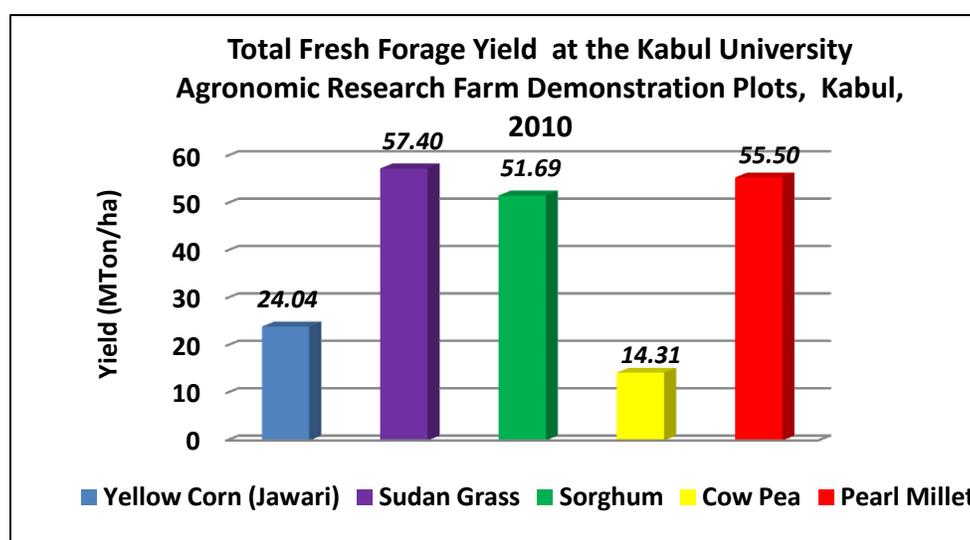
Table 10. Average fresh forage yields of five different summer forage crops: pearl millet, sudan grass, cowpea, sorghum, and local yellow corn (Jawari) obtained at the College of Agriculture, Kabul University in the summer growing season of 2010

NN	Station Name	Forage Crop	Cut	No of Replications	Average Fresh Yield Per Cut	St. Dev. Fresh Forage Yield	Range of Fresh Forage Yield	Total Fresh Forage Yield
					M Ton per Hectare			
1	Kabul University	Yellow Corn (Jawari)	1	4	24.04	3.66	20.5 - 27.2	24.04
2	Kabul University	Sudan grass	1	4	30.53	10.83	19.1 - 45.0	57.40
3	Kabul University	Sudan grass	2	4	26.88	4.82	22.0 - 33.5	
4	Kabul University	Sorghum/Sudan Hybrid	1	4	26.06	8.82	17.7 - 38.5	51.69
5	Kabul University	Sorghum/Sudan Hybrid	2	4	25.63	0.95	25.0 - 27.0	
6	Kabul University	Cowpea	1	4	7.24	2.01	4.8 - 9.2	14.31
7	Kabul University	Cowpea	2	4	7.08	1.02	6.3 - 8.1	
8	Kabul University	Pearl Millet	1	4	26.63	10.61	15.1 - 40.6	55.50
9	Kabul University	Pearl Millet	2	4	28.88	7.20	21.5 - 38.5	

Table 11. Total fresh forage yield (M Ton/ ha) of five tested forage crops as a percentage of the total accumulated yield obtained from two cuts at the College of Agriculture, Kabul University in the summer growing season of 2010

Forage Crop	First Cut		Second Cut		Total of 2 cuts (M Ton/ha)
	Yield (M Ton/ha)	% of the total	Yield (M Ton/ha)	% of the total	
Yellow Corn (Jawari)	24.04 ^A	100.00	0.00 ^C	0.00	24.04 B
Sudan Grass	30.53 ^A	53.18	26.87 ^A	46.82	57.40 A
Sorghum	26.06 ^A	50.42	25.63 ^A	49.58	51.69 A
Cow Pea	7.24 ^B	50.57	7.07 ^B	49.43	14.31 B
Pearl Millet	26.62 ^A	47.96	28.88 ^A	52.04	55.50 A
CV (%)	31.53		21.75		26.06
LSD (0.05)	11.12		5.93		16.30
LSD (0.05) Sudan Grass	14.50				
LSD (0.05) Sorghum	10.85				
LSD (0.05) Cow Pea	2.69				
LSD (0.05) Pearl Millet	15.69				

Figure 13. Total fresh forage yields of five different summer forage crops: pearl millet, sudan grass, cowpea, sorghum, and local yellow corn (Jawari) obtained from two cuts at the College of Agriculture, Kabul University in the summer growing season of 2010



Summary of results

- The obtained number of cuts was two cuts per summer growing season that was partly due to the late plantation on July, 2010.
- The total fresh forage yields from two cuts per growing season were 57.4, 55.5, 51.7, 24.0, and 14.3 M Ton/ha for sudan grass, pearl millet, sorghum/sudan hybrid, local yellow corn (Jawari), and cowpea respectively.

Recommendations

- Based on the results and findings documented above, we recommend that this adapted, promising, high yielding, highly nutritional and long growing season forage pearl millet, Sudan grass, and cowpea crops to be registered and certified at MAIL Seed System as new forage crops for the benefit of the Afghan farmers, herders, dairy productions and for the agricultural production enhancement in Afghanistan.
- National Afghan seed enterprises should include the forage pearl millet as the first forage crop to be produced according to the new seed law of Afghanistan.
- As a forage legume with highly nutritional values, cowpea is usually used in mixtures with other forage grasses such as pearl millet and Sudan grass. Therefore, it is highly recommended to be registered and certified as a newly forage legume.

On Farm Demonstration Plots

In the summer of 2010, the AWATT Forage Program established seed and forage production demonstration plots at MAIL Badam-Bagh Research Farm (MBBF) and at the College of Agriculture Agronomic Research Farm, Kabul University in Kabul City, Kabul Province.

MAIL Badam-Bagh Research Farm (BBF)

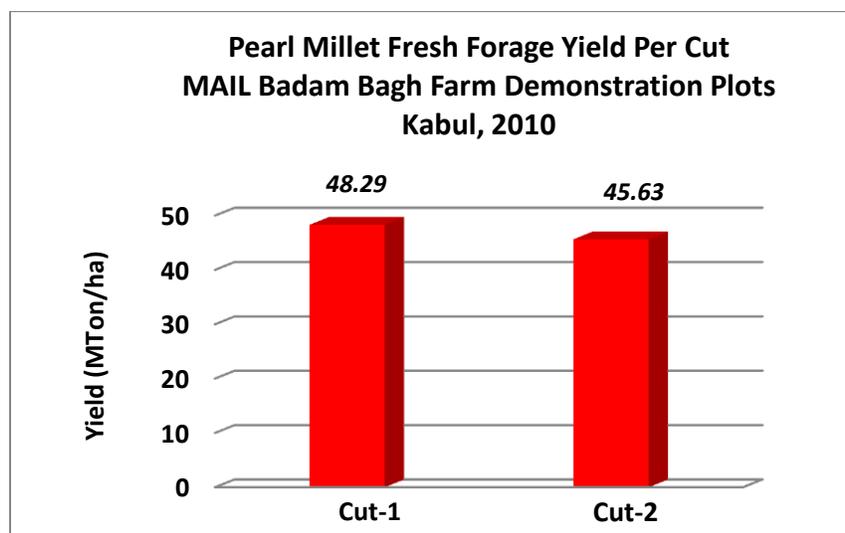
A plot furrows demonstration was established for each of the forage crops: pearl millet, sudan grass, cowpea, and alfalfa seed and forage production.

The results for the fresh forage yield of pearl millet forage crops obtained at MAIL Badam-Bagh Research Farm in the summer of 2010 are displayed in Table (12) and Figure (14).

Table 12. Average fresh forage yield of pearl millet forage crop obtained at MAIL Badam-Bagh Research Farm, Kabul Province in the summer growing season of 2010

NN	Station Name	Forage Crop	Cut	No of Replications	Average Fresh Yield Per Cut	St. Dev. Fresh Forage Yield	Range of Fresh Forage Yield	Total Fresh Forage Yield
					MTon per Hectare			
1	MAIL Badam Bagh Farm	Pearl Millet	1	12	48.29	11.38	31.0 - 63.5	93.92
2	MAIL Badam Bagh Farm	Pearl Millet	2	12	45.63	5.20	37.5 - 50.5	

Figure 14. Average of the fresh forage yield (MTon/ha) of pearl millet obtained from two cuts at MAIL Badam-Bagh Research Farm, Kabul Province in the summer growing season of 2010



Summary of results

- The obtained number of cuts was two cuts per summer growing season that was partly due to the late plantation in July, 2010.
- The total fresh forage pearl millet yield per growing season from two cuts was 93.92 MTon/ha.
- The fresh forage yields recorded per cut 1 and 2 were 48.3 and 45.6 MTon/ha respectively.

Recommendations

- Based on the above documented results and findings, we recommend that this adapted, promising, high yielding, highly nutritional and long growing season forage pearl millet, be registered and certified at MAIL Seed System as a new forage crop for the benefit of the Afghan farmers, herders, dairy productions and for the agricultural production enhancement in Afghanistan.
- National Afghan seed enterprises should include the forage pearl millet as the first forage crop to be produced according to the new seed law of Afghanistan.

Agronomic Research Farm, Kabul University

In June 2010, the AWATT Forage Program established applied forage irrigation research and demonstration programs at the Agronomic Research Farm, Kabul University which was in addition to alternative and furrow irrigation systems demonstrations for pearl millet, sudan grass and cowpea.



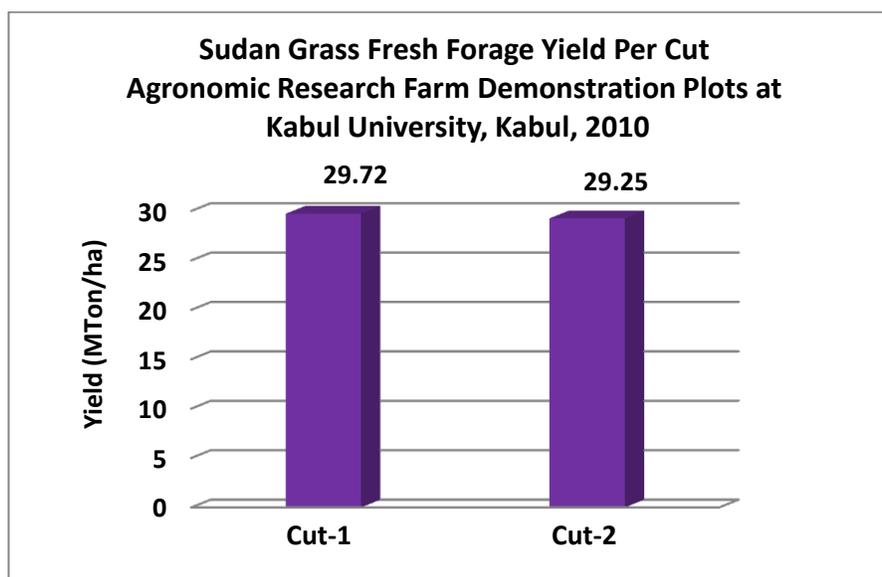
Irrigation systems for every furrow and for alternate furrows were demonstrated on seed production plots

The results for fresh forage yield of Sudan grass obtained at Kabul University Agronomic Research Farm in the summer growing season of 2010 are displayed in Table (13) and Figure (15).

Table 13. Average fresh forage yield of Sudan grass forage crop obtained from Kabul University Agronomic Research Farm, Kabul Province in the summer growing season of 2010

NN	Station Name	Forage Crop	Cut	No of Replications	Average Fresh Yield Per Cut	St. Dev. Fresh Forage Yield	Range of Fresh Forage Yield	Total Fresh Forage Yield
					MTon per Hectare			
1	Kabul University	Sudan Grass	1	16	29.72	12.87	14.8 - 54.0	58.97
2	Kabul University	Sudan Grass	2	16	29.25	8.80	17.5 - 49.5	

Figure 15. Average of fresh forage yield (MTon/ha) of sudan grass obtained from two cuts at MAIL Badam-Bagh Research Farm, Kabul Province in the summer growing season of 2010



Summary of results

- The obtained number of cuts was two cuts per summer growing season that was partly due to the late plantation in July, 2010.
- The total fresh forage yield was 59.0 MTon/ha for sudan grass per growing season from two cuts.
- The fresh forage yields recorded per cut 1 and 2 were 29.7 and 29.3 MTon/ha respectively.

Recommendations

- Based on the results and findings documented above, we recommend that this adapted, promising, high yielding, highly nutritional and long growing season forage Sudan grass be registered and certified at MAIL Seed System as a new forage crop for the benefit of the Afghan farmers, herders, dairy productions and for the agricultural production enhancement in Afghanistan.
- National Afghan seed enterprises should include the forage sudan grass as the second forage crop after pearl millet to be produced according to the new seed law of Afghanistan.

Forage Foundation Seed Production

During the 2010 growing season, 550 kg of sudan grass and 297 kg of forage cowpea foundation seeds were produced at the MAIL Badam-Bagh Research Farm in Kabul City, Kabul Province. The produced foundation seeds will be delivered by AWATT Forage Program team to MAIL,

where they will be registered and certified by MAIL Seed System and multiplied by local seed enterprises.



Cowpea seed production field of Cream-1 variety from Egypt; cowpea pods are in the maturity stage at MAIL-Badam Bagh Agricultural Research Station, Kabul in October 2010



Cowpea seeds were harvested by trained workers in plastic baskets and transferred from the field to the collective site at MAIL-Badam Bagh Agricultural Research Station, Kabul in October 2010



Sudan grass seeds were ready to be harvested at MAIL-Badam Bagh Agricultural Research Station, Kabul in October 2010



Pearl millet seeds were ready to be harvested at MAIL-Badam Bagh Agricultural Research Station, Kabul in October 2010

TOTAL FORAGE FOUNDATION SEED PRODUCED IN AFGHANISTAN UNDER AWATT FORAGE TECHNOLOGY TRANSFER PROGRAM IN 2010

MAIL/Herat Agricultural Research Station in Herat Province:

Pearl Millet	125 kg
Sudan Grass	120kg
Cowpea	70kg

MAIL/Badam Bagh Agricultural Research Station in Kabul Province:

Sudan Grass	550kg
Cowpea	297kg

MAIL/Balkh Agricultural Land in Balkh Province:

Pearl Millet	543 Kg
Sudan Grass	136 Kg
Cow Pea	32 Kg

Total Pearl Millet	668kg
Total Sudan Grass	806kg
Total Cow Pea	399kg
Grand Total	1,873 kg

TOTAL FORAGE FOUNDATION SEED PRODUCED IN AFGHANISTAN UNDER AWATT FORAGE TECHNOLOGY TRANSFER PROGRAM IN 2009 AND 2010

In 2009:

Pearl Millet **750 kg**

In 2010:

Pearl Millet 668 kg

Sudan Grass 806 kg

Forage Cowpea 399 kg

Total in 2010 1,873 kg

Total Produced: 2,623 Kg

The amount of forage foundation seeds used on forage demo plots by farmers is **1,213 Kg**

The amount of forage foundation seeds delivered to MAIL for multiplication is **1,410 Kg**

CONCLUSION

In over three years, 2009-2011, the AWATT Forage Technology Transfer Program has developed a long term strategy not only to improve forage production in Afghanistan but also to sustain this productivity in Afghanistan. It had been planned to be done through several forage components within this strategy as follows:

- First: To introduce highly productive nutritional adapted forage crops;
- Second: To test and evaluate these newly introduced forage crops at three levels:
- MAIL/Agricultural Research Stations;
 - Farmer-owned land;
 - Colleges of Agriculture of selected Universities.
- Third: To demonstrate the yield performance and the impact of these forage crops on livestock production at the farmer-owned land.
- Fourth: To build Afghanistan's national capacity: farmers, MAIL and DAIL researchers and extension workers, Universities faculty members and students, and Vocational Agricultural Institutes teachers and students.
- Fifth: To produce the foundation seeds for these promising adapted forage crops in order to be registered, certified by MAIL and multiplied by local seed enterprises for sustainability of all these efforts and investments to improve and sustain forage production in Afghanistan.

AWATT and partners must provide support to the Provincial DAIL and MAIL until the government of Afghanistan is capable of assuming full support for the forage seed program. At this stage of the foundation seed development, the forage seed program must be seen as government-led with support from the USAID, AWATT and other coalition agencies, and not the other way around. This ensures that the government is seen as providing basic services to its people, which will help to improve and sustain the forage seed industry and productivity in Afghanistan.

RECOMMENDATIONS

Based on the results and findings documented above, we recommend that this adapted, promising, high yielding, highly nutritional and long growing season forage crops of pearl millet, sudan grass and forage cowpea be registered and certified at MAIL Seed System as a new forage crop for the benefit of the Afghan farmers, herders, dairy producers and for the agricultural production enhancement in Afghanistan. National Afghan seed enterprises should include the forage pearl millet as the first forage crops to be produced according to the new seed law of Afghanistan.

These three forage genotypes are open pollinated crops, in which farmers can produce their own seeds. Therefore, I do recommend that MAIL, should establish a National Forage Research and Demonstration Program based on our work at AWATT Forage Technology Transfer Program in Afghanistan. The proposed Afghan National Forage Program should be based on the following activities:

1. Introduction of new forage crops
2. Testing and evaluation these newly introduced forage crops and forage germplasm
3. Applying the forage research on breeding and best agronomic practices
4. Applying the forage outreach extension and demonstration activities
5. Applying the forage capacity building for MAIL and DAILs' national staff
6. Establishment of forage gene seed bank for future national usage
7. Strengthening of the forage seed industry in Afghanistan
8. Releasing new introduced or locally developed high productive forage crop varieties for Afghan farmers.

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Also, thanks should be extended to MAIL researchers, extension workers who participated in all these activities to evaluate the performance of these introduced forage varieties over seven provinces; in addition to the wonderful national team of AWATT Forage Program who sincerely worked in a team work with MAIL staff to do all these good works in Afghanistan.

In addition, I would like to thank the Egyptian people for their contribution to allow me to transfer these promising forage crop varieties from Egypt to Afghanistan for the benefit of the Afghan people.

Special thanks should be given to H. E. Eng. Abdul Ghani Ghuriani, Deputy Technical Minister of Agriculture in Afghanistan, for his sincere cooperation and support for all our efforts to get the necessary lands of MAIL in Herat, Balkh and Kabul to produce these forage foundation seeds.

Thanks should be extended to Tanya McDonald, Assistant Scientist, at the Ag Econ and Ag Business Department at NMSU for the data analysis and formatting of this report; in addition to Rosanne Norris, Administrative Assistant, in the same department for her editing of this report.

- Hamdy Oushy