Benefits for farmers

- In both sorghum and pearl millet, there is a preference for dual-propose varieties with almost similar values for grain and stover. In this case, the plant height of both crops should be 1.5~1.8 m to enable high stover yield. And this higher stover yield will give sorghum and pearl millet the real advantage over proso millet. There is great interest of in growing sorghum and pearl millet for green forage as well
- There is a good opportunity for crop diversification with both sorghum and pearl millet in salinity-affected areas (both high and moderate salinity). There is a greater scope and opportunity for these crops in non-saline lands where they can give higher grain and fodder (stover as well as green forage) yield.
- The grains of both sorghum and pearl millet can be used equally for livestock feed (mostly poultry feed - both in household and farm sectors) and for food products as it is currently the practice with proso millet. There is considerable knowledge in the region regarding the preparation of various types of food products (and its human health consequences) from proso millet, and hence the use of pearl millet grains for livestock feed and various types of food products will be a rather easy and quick process.

Future directions

- Based on the results of initial preliminary evaluation in Central Asia and those in the Near East region, small-size nurseries of selected dual-purpose and forage type populations of sorghum and pearl millet should be constituted. These should be evaluated, following farmer-participatory procedures, in multi-location trials in Central Asia for at least two years before undertaking extensive on-farm trials and subsequent adoption by farmers.
- The trials should be conducted as a main crop as well as a second crop. Also, the trials should be conducted at a few selected locations under leached and un-leached treatments to assess yield potential and salinity tolerance with respect to both grain and fodder yield.
- In case of pearl millet, ~3 cycles of simple mass selection within selected populations should be carried out to improved their productivity and uniformity with respect to plant height, flowering time and panicle traits (size and shape).
- In addition to the identification/development of high-yielding and salinity-tolerant cultivars, adoption of improved agronomic practices can further improve the productivity of these cultivars. For instance, under subsistence rainfed farming conditions in India, grain yields are low both in sorghum (900~1000 kg ha-1) and pearl millet (700~800 kg ha-1). However, when grown as irrigated crops with 60~80 kg ha-1 applied nitrogen, sorghum hybrids can give as high as ~8-10 t ha-1 of grain yield and pearl millet hybrids can give ~4-5 t ha-1 of grain yield. Thus, improved agronomic practices (planting time, seed rate, spacing, fertilizer application, weed control, and crop rotation) should be developed for further enhancement of the productivity of selected populations.
- It has been observed that crop rotation with pearl millet reduces nematode problem in wheat, soybean and potato; and that crop rotation with sorghum reduces a root rot problem in wheat. Experiments should be set up to examine the effect of pearl millet and sorghum on nematode and root rot problem (if they exist in the region).
- For the longer-term, high-yielding and salinity-tolerant populations should be used in hybridization programs to develop varieties with greater yield potential and salinity tolerance. Hybrids have been found to have 25~30% grain yield advantage (and at least, as much fodder yield advantage) over varieties both in sorghum and pearl millet. To develop a hybrid program, a wide range of parental lines of these crops developed at ICRISAT should be evaluated for their adaptation in Central Asia and those found promising should be tested for their hybrid performance.
- The regional capacity for genetic improvement, seed production and crop management of sorghum and pearl millet should be enhanced with back up support from ICRISAT, ICBA and ICARDA.
- ICRISAT, ICBA, ICARDA and NARS in the Central Asia region should join hands to develop a joint research project for mobilizing adequate resources to support the above activities to develop cultivars and crop production technologies for enhancing the productivity of these crops in the Central Asia.

Sorghum and Pearl Millet for Crop Diversification, Improved Crop-Livestock Productivity and Farmers Livelihood in Central Asia

ICARDA

Introduction

Limited water resources, soil salinity and poor soil fertility are the major constraints to crop-livestock production in Central Asia. Adoption of crop species adapted to such environments, and further enhancement of their yield potential and quality provides a cost-effective and sustainable solution to meet household food, feed and fodder needs of farmers for their livelihood improvement. Sorghum [Sorghum bicolor (L.) Moench), grown on 43 million ha worldwide, is a major warm-season cereal of the semi-arid tropics. Pearl millet [Pennisetum glaucum (L.) R. Br.), grown on 26 million ha, is a major warm-season cereal in the arid and semi-arid regions of Africa and Asia. In the developing countries in these regions, both crops are important components of low-resource agriculture, and are primarily grown for food uses. These are also valued as feed, stover (dry stalk after grain harvest) and forage crops. Both crops have high water-use efficiency, and are highly tolerant to drought and soil salinity. These features make sorghum and pearl millet especially suitable for crop diversification and crop-livestock productivity enhancement in Central Asia.

Sorghum and pearl millet grain and forage purposes in Central Asia with very little cultivar diversity. Farmers in the region are familiar with proso millet and its use for food, feed and fodder. Pearl millet with higher grain and fodder yield can partially replace proso millet and occupy new niches, leading to crop diversification and enhanced crop-livestock productivity in the region.

A 3-year project "Sorghum and Pearl Millet for Crop Diversification Improved Crop-Livestock Productivity and Farmers Livelihood in Central Asia" financially supported by the Islamic Development Bank (IDB) and coordinated by ICBA in close collaboration with ICRISAT, ICARDA-CAC and the national agricultural research systems (NARS) of three partner countries in Central Asia was launched from July 2011.

The Main Goal of this project is to contribute to the Improvement of livelihoods of farmers in salinity-affected and marginal environments of the Central Asia region through the development and dissemination of high-yielding, salinity-tolerant sorghum and pearl millet lines and cultivars, as well as crop management technologies for economic and sustainable crop-livestock production systems in Tajikistan, Uzbekistan and Kazakhstan.

Plant material was extensively evaluated on low saline soils at "Zangyota" Uzbek Corn Station (Uzbekistan) , "Ziroatkor" Production Farm, Institute of Plant Husbandry of Tajik Agricultural Academy of Sciences and Abay district, Chimkent region (southern Kazakhstan), on moderately and high saline soils at Shortanbay Farm, Nukus region, Karakalpakstan and Institute of Rice Production, Kyzylorda (Kazakhstan). Above-mentioned sorghum and pearl millet promising germplasm from ICBA and ICRISAT was also evaluated under rainfed conditions of Almaty region in Kazakhstan.

This article represents some of the major findings emerging from the evaluation of these two valuable cereals in different regional nurseries and discussions with scientists, administrators and farmers in the region; and an outline for future directions.

Results

Sorghum and pearl millet can be cultivated as main crops (planted in April to mid- May) or as second crop (planted in mid-June to early July) after wheat harvest. The appropriate maturity requirement both in main crop and second crop will depend on the time of onset of the frost. For instance, in northern part of Kazakhstan, Tajikistan and in Nukus (Uzbekistan) when planted as a main crop sorghum varieties maturing in 120~140 days can be taken only as a main crop as the frost starts early in this area. At Samarkand, Mirzachili steppe, Central Kyzylkum Desert and southern Kazakhstan however, sorghum and pearl millet varities can be taken as a main crop as well as a second crop. Early maturity varieties with 85 to 90 days maturity will fit as a main crop in all the eco-regions. As a second crop also, pearl millet with 65~70 days maturity will have a good chance of fitting under the prevailing cropping system in all the eco-regions.

Screening of more than 52 improved lines of pearl millet through on-station and farmer-participatory on-farm trials under different filed management practices identified Sudan Pop III, Guerinian-4, IP 6104, IP 6112, IP 13150, IP 19586, HHVBC Tall, ICMV 7704 and MC 94 C2 as the most salt/drought tolerant and highly productive varieties for food and forage production.

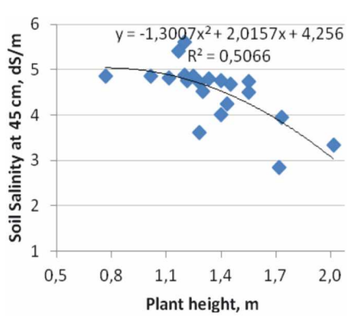
Among evaluated so far sorghum varieties ICSV 93046, ICSSH 58, SPV 1411, ICSR 93034, ICSV 25280, S 35, Sugar Graze, Pioneer 858 at a plant height of 204-262 cm exceeded the standard Korabosh variety in 14.32-23.66 kg/ plot of green matter and 1.85-4.01 kg/plot of dry matter. All of these improved lines of sorghum have demonstrated about 30% higher dry fodder and 25% higher seed yield than the local varieties.

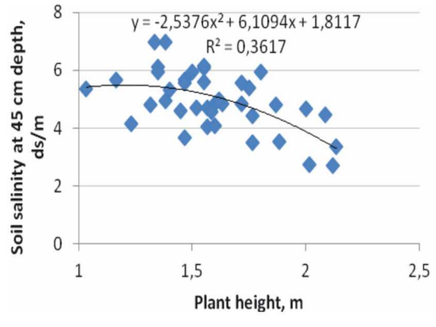
These two crops sowing with 30cm inter-rows space significantly increase the plant density and, consequently the fresh forage production at the end of harvesting of sorghum and pearl millet from the fields. Sorghum varieties maturing in 110-140 days can be taken only as a main crop as the frost starts early in this area. Pearl millet with 85 to 90 days maturity fits well as second crop in southern Kazakhstan, Prialaralie (entire Aral region) eco-region under saline environments. The early term seed bedding (middle of March at soil temperature +5-10C) as was demonstrated in a trial in Kyzylkesek (Central Kyzylkum) allowed to obtain three cuts (7, 8-9.1 kg/plot green forage) until late October.

Development of sorghum and pearl millet varieties resistant to abiotic stress

Monitoring of irrigation water, ground water and soil salinity level (at different soil depth profile -15, 30, 45 cm) by using EC meter (Direct Soil EC meter) during sorghum and pearl millet vegetation season at Bayavut and Kyzylkesek Farms (Uzbekistan), Shortanbay farm (Karakalpakstan, Uzbekistan) and at experimental station of Kyzylorda Institute of Rice Production (Kazakhstan) showing the trend (ecological raw) of increasing of salt tolerance.

Average threshold salinity levels for examined sorghum varieties ranged from 2.60 to 8.5 dS m-1 ; and from 2,4 up to 4.6 dS m-1 for pearl millet entries respectively. New released variety “Hashaki 1” has an intermediate position, while the lowest plant density (467 plants/ha) was observed for Raj171. New local variety is resistant to moderate soil salinity and low quality water with grain yield 2.96 t/ha. Thus, sorghum and pearl millet varieties derived from ICRISAT and ICBA germplasm normally can be classified as moderately salt-tolerant crops. Pearl millet was more sensitive than sorghum to soil and water salinity under shallow (0, 5-1, 8 m) and saline water table (1, 5-3.8 dS m-1) as it was demonstrated in a trial in Shortanbay farm, Karakalpakstan, Uzbekistan.





Lead to Success in local Breeding Program

A new dual-purpose and fast maturing variety of pearl millet named “Hashaki 1” was released based on experiments conducted by ICBA and ICRISAT in 2007-2011 in collaboration with Uzbek Scientific Research Center of Agriculture (at Zangyota site, Corn Uzbek Station. This new variety was selected as the result of series of cross-pollinations of HHVBC-Tall improved line from ICRISAT with local varieties.

Relative growth rates, biomass (fresh and dry) and grain production of the new released variety exceeded the local varieties by 2.0-2.5 times. As early maturing pearl millet material “Hashaki-1” performed well in dryland saline environments and could be widely planted as main crop in early spring or as second crop after the wheat harvest or in rice rotation system.

Table1. Characteristics of some morphological, biological and agronomic traits of new promising local variety named “Hashaki 1” (average data 2007-2011).

Average plant height	207cm	The variety is distinguished by its expressive tillering and re-growing ability. Number of basal tillers ranging 3-12
Plant density:	90-110 (A) 180-220 (B)	A- as main crop for grain production; distance between rows - 60-70cm; B- summer crop for forage with distance between rows - 30-35cm
Period of vegetation (from seed germination until seed maturation)	90-86 days	Testing Assessment (1-5): Drought tolerance index– 5; Lodging index – 5; Frost tolerance index– 4; Stem fragility – 5
Green biomass	36.07 t/ha	The average yield of green biomass after two cuts varies 45.0 t/ha comparatively with local varieties 27.68 -30.54 t/ha
Absolute dry substances	14.43 t/ha	Two cuts: (first at time to 50% flower) and second cutting – before autumn frosts.
Grain yield	2.96 t/ha	Weight of 1000 seeds-11.8 g; Average weight of panicle with seeds-38,3
Content of juice in the stems	62.5%	Well used for all kind of livestock; showed good palatability.

In 2011 “Hashaki1” was recognized by Uzbek State Varietals Commission as promising variety to be evaluated under different soil-climatic conditions as salt-drought and heat tolerant dual purpose crop. Farmers showed interest to cultivate it mostly for forage (green biomass and silage).

At the moment seed production of this high-yielding variety is under development in order to provide high quality and certified seeds for increasing needs of biosaline agricultural production in Uzbekistan. The main objective of seed production of “Hashaki 1” variety is rapid multiplication by maintaining the varietals identity (a spatial filed isolation of about 1000 m with periodically renovation from breeder seeds) and genetic purity.

Seed Multiplication Trials

On farm level seed multiplication trials (of about 0.3 ha) and identification of seed production facilities on sentinel sites to meet seed with participatory work of farmers requirements for yield trials Specialized on-farm seed multiplication trials for 4 promising sorghum ICSV 93046, SPV 1411 sorghum, 3 pearl millet (HHVBC Tall, IP 19586, MC94C2) from ICRISAT along with locally new released Hashaki1 variety were established in Kyzylkesek and Zangyota sites in Uzbekistan; Abay farm southern Kazahstan and Gafurov Farm in Tajikistan. Selected farmers are producing the seed under fish nets and/or by using selfing-bags to protect from bird damage. In Tajikistan 28 farmer were identified and invited to form a social network for pearl millet seed production. Seeds can be specially produced by separate or cluster farmers of nearby villages on a remunerative price to recover the cost of seed production, plus 30-50% profit.

Laboratory standard analytical methods and field performance were analyzed to quantify seed quality (germination rate; energy of germination; seed viability) of sorghum and pearl millet seed, produced by farmers. Variety purity and seeds maintained by farmers were also assessed for different seed sources. The seed quality assessment showed that farmer produced seed is generally of medium quality.

Seed producing farmer will visualize some benefit in producing the seed for an incentive, and hence can ensure adequate and timely supply of quality seeds. The International Centers and National Institutions in the target area of seed production are providing technical guidance for quality seed production.


ЕГІН ДАЛАСЫ ЕҢБЕК МАЙДАНЫНА АЙНАЛДЫ