Dual-purpose Varieties for Crop and Livestock Integration

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Summary

Diminishing productivity of natural pastures and rangelands across African drylands due to overgrazing, soil degradation and climate change, coupled with increasing livestock numbers, increases the importance of crop residues used as animal feeds. Traditional varieties of millet and sorghum are unable to satisfy demands for food and feed at the same time as they do not have a favorable ratio of grain to stover. Commonly cultivated lines also have a higher lignin content, reducing their digestibility, while some also contain sufficient tannin to lend a bitter taste. New higher yielding, “dual-purpose” millet and sorghum varieties with ideal grain and stover ratios for both human and animal nutrition are now available. These improved cultivars contain less lignin and tannin, and stay green through grain harvest, allowing farmers to obtain greater fodder quantity and quality into the dry season. The new lines of millet and sorghum allow more intensive crop-livestock integration as improvements in fodder availability enhance manure availability for use in soil fertility management.

Technical Description

Varieties for dual-purpose produce about 40% of grain and 60% of stover on dry matter basis. Sorghum lines achieve grain yields of 2.5 - 4.0 ton ha-1 and stover yield of 10 - 15 ton ha-1. For millet cultivars, the productivity ranges between 2.0 and 2.5 ton ha-1 for grain, and 4.0 - 6.0 ton ha-1 for stover. The new cultivars possess traits that help them survive dry-spell and quickly resume growth when moisture returns. In addition, sorghum lines tolerate both drought and cold better than other fodder crops such as maize and Napier grass. The stover of the dual-purpose sorghum cultivars is sweet with a sugar concentration around 15%, matching the energetic value of maize, and its juice can be extracted for syrup or bioethanol production as well. While traditional millet varieties achieve higher production of fodder on dry matter basis, the new dual-purpose lines provide greater digestible stover yield and metabolizable energy per area of land. Improvements of harvestable grain and stover, nutritional quality and stress resistance in millet and sorghum offer greater food and feed security to farmers.

Uses

Dual-purpose varieties available to seed producers are suitable for a wide range of African agroecosystems through selective adaptation for specific growing conditions, including Sahelian and Miombo drylands and sub-humid regions.

Composition

ICRISAT and partners from the Institut d'Economie Rurale in Mali developed and registered more than 15 OPV and hybrid lines of dual-purpose sorghum, including cvs. Soubatimi, Tiandougou Coura, Jiguikala, Seguifa, Peke, Fadda, Sewa, Nieleni, Grinkan Yerewolo, Sassilon and Sariasso 22. A series of OPV and hybrid cultivars of dual-purpose millet are available, including MISARI 1 and 2, NAFAGNON, ICMV, ICMH, Mil de Siaka, SOSAT-C88, Toroniou C, Synthetique 00-06/03-03 and Thialack 2.

Means of application

The dual-purpose varieties are developed using conventional techniques of crossing and hybridization and subjected to rigorous field tests before their release. Land preparation, seed rate, plant spacing, fertilizer application, and crop management should follow generally prescribed practices for growing areas and seasons. It is important to note that sorghum stover is wilted for at least 12 hours before feeding to animals so that hydrogen cyanides are broken down, else these they may cause poisoning. Green or dry stover must be chopped into pieces of 2 cm when used as fodder for cows, pigs, and goats, and must be shredded into pieces of less than 0.5 cm for poultry. Millet and sorghum stover can be used for silage in pits or under plastic during which fermentation releases extra sugar and breaks down anti-nutrients. Because of the high sugar content in sorghum, no molasses must be added to silage. Fodder from sorghum, either as green chop or silage, can replace maize at equal amounts for all types of livestock, and provides up to 67% of required roughage and up to 20% of the total diet.

Agroecologies	Dryland area, Moist savanna.
Regions	Africa South of Sahara.
Developed in Countries	Burkina Faso, Chad, Ethiopia, Kenya, Mali, Niger, Nigeria, Senegal, Sudan, Tanzania, Zimbabwe.
Available in	Burkina Faso, Chad, Ethiopia, Kenya, Mali, Niger, Nigeria, Senegal, Sudan, Tanzania, Zimbabwe.
Solution Forms	Genetics.
Solution Applications	Improved variety, Feed/Fodder Production.

Agricultural Commodities	Sorghum/Millet.
Target Beneficiaries	Women, Youth, Small-scale farmers, Commercial farmers.

Commercialization

Commercialization Category

Commercially available

Startup Requirements

The following actions must be taken to realize widespread adoption: 1) Campaigns to raise awareness about benefits for human nutrition, fodder quantity and quality, and climate resilience, 2) Design of investment and regulatory roadmaps by public agencies and private companies to create formal seed delivery systems, 3) Capacity building of seed producers on quality assurance standards and frameworks essential for the multiplication of certified seed, and 4) Banks provide low-interest credit for seed companies to expand seed portfolio and micro-loan programs for farmers to buy the improved varieties.

Production Costs

Seed and grain of new dual-purpose varieties are sold at the standard market prices and thus do not change the cost of seed for farmers. Overall production costs of dual-purpose varieties are significantly higher than fodder only varieties due to additional labor needs for bird control and threshing. Indian farmers cultivating dual-purpose millet typically spend a total of US $204 per hectare for seed, fertilizer, and labor.

Customer Segmentation

The customer base for dual-purpose millet and sorghum varieties are private seed companies, cooperatives, and seed growers that bulk and marketed seed, and small-scale and commercial farmers that also produce animals.

Potential Profitability

A huge market potential for improved lines exists across Africa’s drylands as hundreds of millions of households depend on mixed crop-livestock farming. Dual-purpose varieties offer greater returns per area of land than those for grain or fodder only, thus increase incomes. Earnings from dual-purpose pearl millet lay 31% higher than fodder millet, and 63% than grain millet.

Licensing Requirements

Varieties of millet and sorghum for dual-purpose are released for multiplication and sales under a royalty-free license but require certification following national regulations.

Innovation as Public Good

Dual-purpose varieties are classified as a Regional Public Good. ICRISAT and national research centers are responsible for dissemination.

Solution Images

Dual-purpose millet varieties in Niger

Institutions

ICRISAT
INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

Accompanying Solutions

Proactive Management of Striga Infestation

Fertilizer Micro-Dosing to Enhance Yield and Use Efficiency

Motorized Crop Residue Processing of Animal Feed