

TECHNICAL SHEET

Intensification system by cereal/legume association (millet/mung beans)

Presentation of the millet

The common name millet refers, in a broad sense, to several grass species including, among others, *Pennisetum glaucum*, *Eleusine coracana*, *Panicum miliaceum*, *Setaria italica*, *Echinochloa crusgalli* (Saïdou, 2011 cited by Kadri et al, 2019). Pearl millet or candle millet, *Pennisetum glaucum*, represents 40% of the world's millet production (Yang et al., 2012 cited by Kadri et al, 2019). It is also, the most grown species for human consumption and produces the largest grains (Mariac et al., 2006 cited by Kadri et al, 2019).

Millet is an upright plant with thick stems and heights ranging from 1.5 to 3 m, but millets of nearly 4 meters can be found (Moumouni, 2014 cited by Kadri et al, 2019). The root system is fasciculated with a single main seminal root followed by numerous adventitious roots. One of the causes of millet's good adaptation to the pedoclimatic conditions of the semi-arid zone is its extensive root development, which can reach 300 cm deep at harvest (Ahmadi et al., 2002; ROCAFREMI, 2002 cited by Kadri et al, 2019).

Millet, *Pennisetum glaucum*, is the most drought tolerant cereal. It is grown in regions where rainfall is between 150 and 800 millimeters (Besançon et al, 1997). In Africa, 70% of production comes from the west of the continent. The main producing countries are, in decreasing order of importance: Nigeria, Niger, Burkina, Chad, Mali, Mauritania and Senegal (Besançon et al, 1997). It is often the staple food and is consumed in the form of paste, porridge, couscous or pancakes (Besançon et al, 1997). It can also be used to make alcoholic beverages such as millet beer (Besançon et al, 1997).

Millet seed

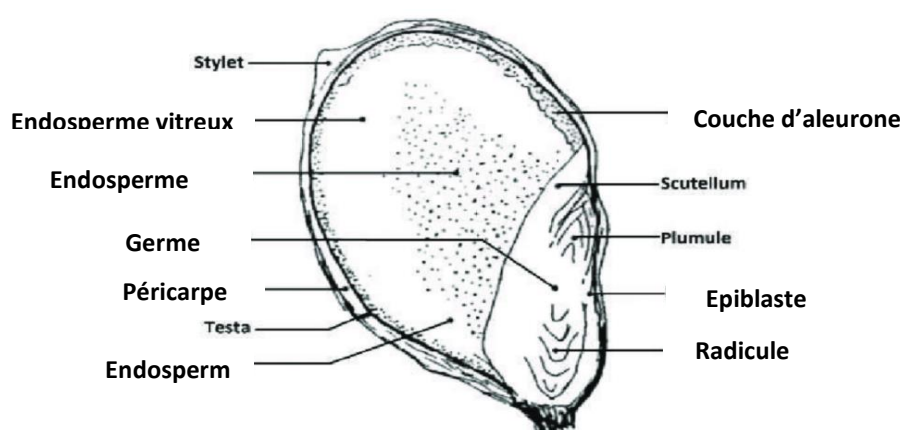


Figure 1 : section of a millet seed (source : Rao et al, 2017)

Presentation of the bean

The bean (*Phaseolus vulgaris*) belongs to the large family of seed legumes, as do cowpeas, pigeon peas (*Cajanus cajan*) and voandzou. It belongs to the Fabaceae family. The bean is cultivated mainly for its seeds which constitute an important source of vegetable protein in the human diet (even for vegetarians). In addition, the stem is used as animal fodder, while the leaves and stems, when buried in the soil, contribute enormously to the enrichment of the soil in nitrogen.

Bean seed

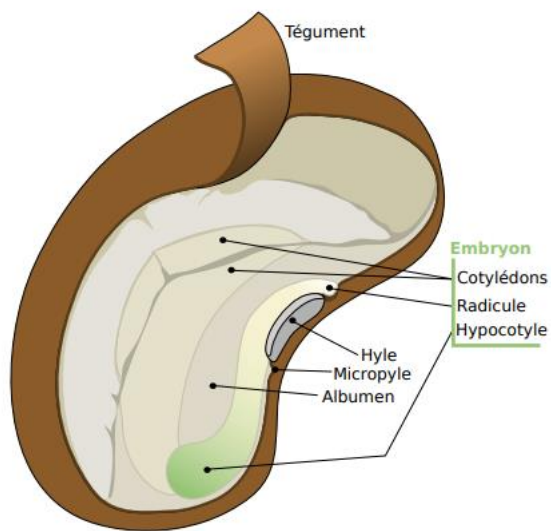


Figure 1 : bean seed (source : [https://www.doc-developpement-durable.org/file/Culture/Culture-plantes-alimentaires/FICHES PLANTES/haricots/Haricot_Wikipedia-Fr.pdf](https://www.doc-developpement-durable.org/file/Culture/Culture-plantes-alimentaires/FICHES_PLANTES/haricots/Haricot_Wikipedia-Fr.pdf))

Characteristics of the technology

2 lines of legumes (here mung bean) in 2 lines of millet sown at high density (spacing 0.45 m instead of 0.9 m) and spaced at 1.8 m to allow the legume to perceive the light; 150% increase in millet yield in Niore, Senegal without compromising the LER (Land Equivalent ratio).

Références bibliographiques

Ahmadi N, Chantereau J, Hekimian Lethève C, Marchand JL., Ouendeba B, (2002) : Le mil. In Mémento de l'agronome : Les céréales. CIRAD-GRET (ed). Ministère des Affaires étrangères ; 17-23 p.

Besançon G., Renno J-F., Kumar K.A. (1997) : L'amélioration des plantes tropicales ; CIRAD ; ORSTOM ; 457-478p.

CDDR/SAILD (2017) : CULTURE DU HARICOT ROUGE OU HARICOT COMMUN (PHASEOLUS VULGARIS) ; article publié ; 6p.

KADRI A., HALILOU H., KARIMOU I. (2019) : Culture du mil [Pennisetum glaucum (L) R. Br] et ses contraintes à la production : une revue ; 524p.

LOUMEREM M. (2004) : Etude de la variabilité des populations de mil (Pennisetum glaucum (L.) R. Br.) cultivé dans les régions arides tunisiennes et sélection de variétés plus performantes. Thèse, Université de Gen, Gen, p. 266.

Mariac C, Luong V, Kapran I, Mamadou A, Sagnard F, Deu M, Chantereau J, Gerard B, Ndjeunga J, Bezancon G, Pham J, Vigouroux Y. (2006) : Diversity of wild and cultivated pearl millet accessions [Pennisetum glaucum (L.) R. Br.] in Niger assessed by microsatellite markers. Theor. Appl. Genet, 114: 49–58. DOI: <http://dx.doi.org/10.1007/s00122-006-0409-9>.

MAITI RK, BIDINGER FR. (1981) : Growth and development of the pearl millet plant. Research Bulletin N°6, ICRISAT Patancheru, Patancheru, 19 p.

MOUMOUNI KH. (2014) : Construction d'une carte génétique pour le mil, Pennisetum glaucum (L.) R.Br, par une approche de génotypage par séquençage (GBS). Mémoire, Université de Laval de Québec, Québec, 111 p.

PASSOT S. (2016) : Exploration du système racinaire du mil et ses conséquences pour la tolérance à la sécheresse ; thèse de Doctorat ; Spécialité : Biologie, Interactions, Diversité Adaptative des Plantes CNU : Physiologie ; Université Montpellier ; 140p.

ROCAFREMI. (2002) : Sélection et Mise à Disposition des Paysans de Variétés et de Semences Appropriées. Des Résultats du Projet P1 : 1991-1996.

SAÏDOU A. (2011) : Etude moléculaire, évolution et caractérisation de gènes impliqués dans l'adaptation du mil [Pennisetum glaucum (L.) R. Br.] aux changements climatiques. Thèse de doctorat, Montpellier SupAgro, Montpellier, 236 p.

Yang X, Wan Z, Perry L, Lu H, Wang Q, Zhao C, Li J, Xie F, Yu J, Cui T, Wang T, Li M, Ge Q. (2012) : Early millet use in northern China. Proc. Nat. Acad. Sci. USA, 109(10) : 3726-3730. DOI: <http://www.pnas.org/cgi/doi/10.1073/pna.s.1115430109>.

Web sites consulted

<https://agritrop.cirad.fr/582726/1/th%C3%A8seSixtinePassot.pdf> ; 11/08/2021 at 15h33

https://horizon.documentation.ird.fr/exl-doc/pleins_textes/divers09-03/010012930.pdf ; 11/08/2021 at 15h43

<https://www.ajol.info/index.php/ijbcs/article/view/186797> ; 11/08/2021 at 16h01

https://nanopdf.com/download/culture-du-haricot-rouge_pdf ; 22/03/2022 at 09h35

https://www.doc-developpement-durable.org/file/Culture/Culture-plantes-alimentaires/FICHES_PLANTES/haricots/Haricot_Wikipedia-Fr.pdf ; 22/03/2022 at 09h47

https://occitanie.chambre-agriculture.fr/fileadmin/user_upload/Occitanie/076_Inst-Occitanie/Documents/Productions_techniques/Agriculture_biologique/Espace_ressource_bio/Maraichage_bio/ITK-Provence-Haricot-2012.pdf ; 22/03/2022 at 10h38

Other references

Regional Center of Excellency on Dry Cerals and Associated Crops ; HOST INSTITUTION: CENTRE D'ETUDES RÉGIONAL POUR L'AMÉLIORATION DE L'ADAPTATION À LA SECHERESSE (CERAAS) ; Host country: Senegal; Coordinator: Ndjido KANE; Email: ndjido.Kane@isra.sn; ndjido.Kane@isra.sn; Telephone: +221 777232019 / +221 339514693