Material Transfer Agreement (MTA)
for
Breeding Materials under Development by ICRISAT[1]

ICRISAT develops and shares improved breeding materials of mandate crops (sorghum, pearl millet, chickpea, pigeonpea and groundnut) with partners who use these materials to develop improved cultivars for adoption by farmers to enhance production and productivity of mandate crops in the SAT.

The breeding materials (from both conventional and biotechnology-assisted breeding) are products of research carried out wholly or in part by ICRISAT and are the property of ICRISAT. The breeding materials (hereafter referred to as the "material") in the attached list are being furnished by ICRISAT, under the following additional conditions, as allowed in the Standard Material Transfer Agreement (SMTA) for products under development by the Center:

1. ICRISAT is making the material available (as per the Recipient's request) for purposes of research, breeding, and training for food and agriculture, for the exclusive use of _____ (the Recipient).

2. The Recipient will not claim ownership over the material, nor seek Intellectual Property Rights (IPRs) over the material, or its genetic parts or components, in the form received. The Recipient also agrees not to seek IPRs over related information received[2].

3. The Recipient will ensure that the material is exclusively used for purposes of research, breeding and training purposes of food and agriculture in their organization/institution.

4. ICRISAT reserves the right to distribute the materials to other parties.

5. ICRISAT makes no warranties as to the safety or title of the material, as described in Article 9.1 of SMTA.

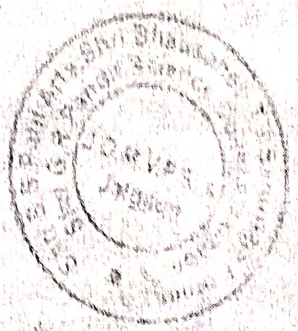
6. Recipients are requested to provide ICRISAT with related data and information collected during evaluation and utilization of the material.

7. All other conditions, as outlined in the SMTA (copy attached) and agreed to by the Recipient, are applicable, except Article 5(a).

Signature: _____ Designation: Principal & MC member, ARMG Jal

Name: Dr. L.P. Deshmukh Institution: J.D.M.V.P. Shri Ars's BITS Commerce & C College Jalg

Address: Shivneri 36, Mahan Nagar, Jalgaon (425001)



[1] MTA for Annex-I material (sorghum, pearl millet, pigeonpea and chickpea).

[2] This does not prevent the recipient from releasing the material (or its products) to farmers for cultivation, provided that the other conditions set out in this MTA are complied with. Materials released should be acknowledged and ICRISAT should be informed of the details.

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CERTIFICATE OF REGISTRATION - NPOP

With reference to your application, we have registered you as INDIVIDUAL PRODUCER and your Registration No. is ORG-1808-001511

Please Note your registration number and use the same in all the future correspondence. Your basic information is given below :

Name :	NANAJI DAMU PATIL
Address :	Mr. Samadhan Nanaji Patil, C/o: Mr. Nanaji Damu Patil, At Post: Sonwad Bk, Dharangaon, Jalgaon, Maharashtra,
Operation Type :	INDIVIDUAL PRODUCER
Status :	Registered
Date of Registration :	13/08/2018
Contact No. :	9665527220
E-Mail ID :	patils9392@gmail.com
PAN :	CSHPP7117E

From the date of Registration this project is under supervision of Vedic Organic Certification Agency, till formally
withdrawn by you. In case of any query, please do not hesitate to contact undersigned.

For Vedic Organic Certification Agency

Certification Manager

Authorised Signatory
Vedic Organic Certification Agency
Plot no-54,Ushodaya Enclave Mythrinagar, Miyapur, Hyderabad, Telangana,

Issued On : 13/08/2018

STANDARD MATERIAL TRANSFER AGREEMENT*

PREAMBLE

WHEREAS

The International Treaty on Plant Genetic Resources for Food and Agriculture (hereinafter referred to as "the Treaty")[1] was adopted by the Thirty-first session of the FAO Conference on 3 November 2001 and entered into force on 29 June 2004;

The objectives of the Treaty are the conservation and sustainable use of Plant Genetic Resources for Food and Agriculture and the fair and equitable sharing of the benefits arising out of their use, in harmony with the Convention on Biological Diversity, for sustainable agriculture and food security;

The Contracting Parties to the Treaty, in the exercise of their sovereign rights over their Plant Genetic Resources for Food and Agriculture, have established a Multilateral System both to facilitate access to Plant Genetic Resources for Food and Agriculture and to share, in a fair and equitable way, the benefits arising from the utilization of these resources, on a complementary and mutually reinforcing basis;

Articles 4, 11, 12.4 and 12.5 of the Treaty are borne in mind;

The diversity of the legal systems of the Contracting Parties with respect to their national procedural rules governing access to courts and to arbitration, and the obligations arising from international and regional conventions applicable to these procedural rules, are recognized;

Article 12.4 of the Treaty provides that facilitated access under the Multilateral System shall be provided pursuant to a Standard Material Transfer Agreement, and the Governing Body of the Treaty, in its Resolution 1/2006 of 16 June 2006, adopted the Standard Material Transfer Agreement.

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[1] *Note by the Secretariat*, as suggested by the Legal Working Group during the Contact Group for the Drafting of the Standard Material Transfer Agreement, defined terms have, for clarity, been put in bold throughout

* In the event that the SMTA is used for the transfer of Plant Genetic Resources for Food and Agriculture other than those listed in Annex I of the Treaty

The references in the SMTA to the "Multilateral System" shall not be interpreted as limiting the application of the SMTA to Annex I Plant Genetic Resources for Food and Agriculture, and in the case of Article 6.2 of the SMTA shall mean, under the Agreement".

The reference in Article 6.11 and Annex 1 of the SMTA to "Plant Genetic Resources for Food and Agriculture belonging to the same crop, as set out in Annex I to the Treaty" shall be taken to mean "Plant Genetic Resources for Food and Agriculture belonging to the same crop"

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ARTICLE 1 — PARTIES TO THE AGREEMENT

1.1 The present Material Transfer Agreement (hereinafter referred to as "**this Agreement**") is the Standard Material Transfer Agreement referred to in Article 12.4 of the **Treaty**.

1.2 **This Agreement** is:

BETWEEN: International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru 502 324, State Telangana, India, represented by its Director General, Dr David Bergvinson (hereinafter referred to as "the **Provider**")

AND: Principal, Shri. S.S.P. Patil Arts, Shri. Bhausaheb T.T. Salunkhe Commerce & Shri. G.R. Pandit Science College, Jalgaon.

(name and address of the recipient or recipient institution, name of authorized official, contact information for authorized official) (hereinafter referred to as "the **Recipient**")

Mob. 9404050969. Ph. 0257-2234094, 2236034
E-mail — jdmvp.prin@gmail.com.

1.3 The parties to **this Agreement** hereby agree as follows:

ARTICLE 2 — DEFINITIONS

In **this Agreement** the expressions set out below shall have the following meaning:

"*Available without restriction*": a **Product** is considered to be available without restriction to others for further research and breeding when it is available for research and breeding without any legal or contractual obligations, or technological restrictions, that would preclude using it in the manner specified in the **Treaty**.

"*Genetic material*" means any material of plant origin, including reproductive and vegetative propagating material, containing functional units of heredity.

"*Governing Body*" means the **Governing Body** of the **Treaty**.

"*Multilateral System*" means the **Multilateral System** established under Article 10.2 of the **Treaty**.

"*Plant Genetic Resources for Food and Agriculture*" means any **genetic material** of plant origin of actual or potential value for food and agriculture.

"*Plant Genetic Resources for Food and Agriculture under Development*" means material derived from the **Material**, and hence distinct from it, that is not yet ready for **commercialization** and which the developer intends to further develop or to transfer to another person or entity for further development. The period of development for the **Plant Genetic Resources for Food and Agriculture under Development** shall be deemed to have ceased when those resources are **commercialized** as a **Product**.

"*Product*" means **Plant Genetic Resources for Food and Agriculture** that incorporate the **Material** or any of its genetic parts or components that are ready for **commercialization**, excluding commodities and other products used for food, feed and processing.

"*Sales*" means the gross income resulting from the **commercialization** of a **Product** or **Products** by the **Recipient**, its affiliates, contractors, licensees and lessees.

As evidenced, for example, by ... reference or restriction on genetic integration.

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ARTICLE 3 — SUBJECT MATTER OF THE MATERIAL TRANSFER AGREEMENT

The **Plant Genetic Resources for Food and Agriculture** specified in *Annex 1* to **this Agreement** (hereinafter referred to as the "**Material**") and the available related information referred to in Article 5b and in *Annex 1* are hereby transferred from the **Provider** to the **Recipient** subject to the terms and conditions set out in **this Agreement**.

ARTICLE 4 — GENERAL PROVISIONS

4.1 **This Agreement** is entered into within the framework of the **Multilateral System** and shall be implemented and interpreted in accordance with the objectives and provisions of the **Treaty**.

4.2 The parties recognize that they are subject to the applicable legal measures and procedures that have been adopted by the Contracting Parties to the **Treaty**, in conformity with the **Treaty**, in particular those taken in conformity with Articles 4, 12.3 and 12.5 of the **Treaty**.

4.3 The parties to **this Agreement** agree that *(the entity designated by the Governing Body)*[1] acting on behalf of the **Governing Body** of the **Treaty** and its **Multilateral System**, is the third party beneficiary under **this Agreement**.

4.4 The third party beneficiary has the right to request the appropriate information as required in Articles 5e, 6.5e, 8.3 and *Annex, 2 paragraph 3,* to **this Agreement**.

4.5 The rights granted to the *(the entity designated by the Governing Body)* above do not prevent the **Provider** and the **Recipient** from exercising their rights under **this Agreement**.

ARTICLE 5 — RIGHTS AND OBLIGATIONS OF THE PROVIDER

The **Provider** undertakes that the **Material** is transferred in accordance with the following provisions of the **Treaty**:

a) Access shall be accorded expeditiously, without the need to track individual accessions, and free of charge, or, when a fee is charged, it shall not exceed the minimal cost involved;

b) All available passport data and, subject to applicable law, any other associated available non-confidential descriptive information, shall be made available with the **Plant Genetic Resources for Food and Agriculture** provided;

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[1] In the case of the International Agricultural Research Centres of the Consultative Group on International Agricultural Research (CGIAR) and other international institutions, the Agreement between the Governing Body and the CGIAR [...] and other relevant institutions will be applicable.

[2] Note by the Secretariat: by Resolution 2/2006, the Governing Body "invite[d] the Food and Agriculture Organization of the United Nations, as the Third Party Beneficiary, to carry out the rights and responsibilities as identified and prescribed in the Standard Material Transfer Agreement, under the direction of the Governing Body, in accordance with the procedures [...] established by the Governing Body at its next session". Upon acceptance by the FAO of this invitation, the term "the entity designated by the Governing Body", will be replaced throughout the document by the term "the Food and Agriculture Organization of the United Nations".

c) Access to **Plant Genetic Resources** for Food and [illegible] including material being developed by farmers, shall be at the discretion of its developer during the period of its development.

d) Access to **Plant Genetic Resources for Food and Agriculture** protected by intellectual and other property rights shall be consistent with relevant international agreements, and with relevant national laws;

e) The **Provider** shall periodically inform the **Governing Body** about the Material Transfer Agreements entered into, according to a schedule to be established by the **Governing Body**. This information shall be made available by the **Governing Body** to the third party beneficiary.[1]

ARTICLE 6 — RIGHTS AND OBLIGATIONS OF THE RECIPIENT

6.1 The **Recipient** undertakes that the **Material** shall be used or conserved only for the purposes of research, breeding and training for food and agriculture. Such purposes shall not include chemical, pharmaceutical and/or other non-food/feed industrial uses.

6.2 The **Recipient** shall not claim any intellectual property or other rights that limit the facilitated access to the **Material** provided under **this Agreement**, or its genetic parts or components, in the form received from the **Multilateral System**.

6.3 In the case that the **Recipient** conserves the Material supplied, the **Recipient** shall make the **Material**, and the related information referred to in Article 5b, available to the **Multilateral System** using the Standard Material Transfer Agreement.

6.4 In the case that the **Recipient** transfers the Material supplied under **this Agreement** to another person or entity (hereinafter referred to as "**the subsequent recipient**"), the **Recipient** shall

a) do so under the terms and conditions of the Standard Material Transfer Agreement, through a new material transfer agreement; and

b) notify the **Governing Body**, in accordance with Article 5e.

On compliance with the above, the **Recipient** shall have no further obligations regarding the actions of the **subsequent recipient**.

6.5 In the case that the **Recipient** transfers a **Plant Genetic Resource for Food and Agriculture under Development** to another person or entity, the **Recipient** shall:

a) do so under the terms and conditions of the Standard Material Transfer Agreement, through a new material transfer agreement, provided that Article 5a of the Standard Material Transfer Agreement shall not apply;

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[1] *Note by the Secretariat*: The Standard Material Transfer Agreement makes provision for information to be provided to the **Governing Body** in the following Articles: 5e, 6.4b, 6.5c and 6.11b, as well as in footnote 2 to paragraph 1 and in paragraph 4. Such information should be submitted to:

The Secretary
International Treaty on Plant Genetic Resources for Food and Agriculture
Food and Agriculture Organization of the United Nations
I-00100 Rome, Italy

b) identify, in *Annex 1* to the new material transfer agreement, the Material received from the Multilateral System, and specify that the Plant Genetic Resources for Food and Agriculture under Development being transferred are derived from the Material;

c) notify the Governing Body, in accordance with Article 5e; and

d) have no further obligations regarding the actions of any subsequent recipient.

6.6 Entering into a material transfer agreement under paragraph 6.5 shall be without prejudice to the right of the parties to attach additional conditions, relating to further product development, including, as appropriate, the payment of monetary consideration.

6.7 In the case that the Recipient commercializes a Product that is a Plant Genetic Resource for Food and Agriculture and that incorporates Material as referred to in Article 3 of this Agreement, and where such Product is not available without restriction to others for further research and breeding, the Recipient shall pay a fixed percentage of the Sales of the commercialized Product into the mechanism established by the Governing Body for this purpose, in accordance with *Annex 2* to this Agreement.

6.8 In the case that the Recipient commercializes a Product that is a Plant Genetic Resource for Food and Agriculture and that incorporates Material as referred to in Article 3 of this Agreement and where that Product is available without restriction to others for further research and breeding, the Recipient is encouraged to make voluntary payments into the mechanism established by the Governing Body for this purpose in accordance with *Annex 2* to this Agreement

6.9 The Recipient shall make available to the Multilateral System, through the information system provided for in Article 17 of the Treaty, all non-confidential information that results from research and development carried out on the Material, and is encouraged to share through the Multilateral System non-monetary benefits expressly identified in Article 13.2 of the Treaty that result from such research and development. After the expiry or abandonment of the protection period of an intellectual property right on a Product that incorporates the Material, the Recipient is encouraged to place a sample of this Product into a collection that is part of the Multilateral System, for research and breeding.

6.10 A Recipient who obtains intellectual property rights on any Products developed from the Material or its components, obtained from the Multilateral System, and assigns such intellectual property rights to a third party, shall transfer the benefit-sharing obligations of this Agreement to that third party.

6.11 The Recipient may opt as per *Annex 4*, as an alternative to payments under Article 6.7, for the following system of payments:

a) The Recipient shall make payments at a discounted rate during the period of validity of the option;

b) The period of validity of the option shall be ten years renewable in accordance with *Annex 3* to this Agreement;

c) The payments shall be based on the Sales of any Products and of the sales of any other products that are Plant Genetic Resources for Food and Agriculture belonging to the same crop, as set out in Annex 1 to the Treaty, to which the Material referred to in *Annex 1* to this Agreement belongs;

d) The payments to be made are independent of whether or not the Product is available without restriction;

e) The rates of payment and other terms and conditions applicable to this option, including the discounted rates are set out in *Annex 4* to this **Agreement**;

f) The **Recipient** shall be relieved of any obligation to make payments under Article 6.7 of this **Agreement** or any previous or subsequent Standard Material Transfer Agreements entered into in respect of the same crop;

g) After the end of the period of validity of this option the **Recipient** shall make payments on any **Products** that incorporate **Material** received during the period in which this Article was in force, and where such **Products** are not available without restriction. These payments will be calculated at the same rate as in paragraph (a) above;

h) The **Recipient** shall notify the **Governing Body** that he has opted for this modality of payment. If no notification is provided the alternative modality of payment specified in Article 6.7 will apply.

ARTICLE 7 — APPLICABLE LAW

The applicable law shall be General Principles of Law, including the UNIDROIT Principles of International Commercial Contracts 2004, the objectives and the relevant provisions of the **Treaty**, and, when necessary for interpretation, the decisions of the **Governing Body**.

ARTICLE 8 — DISPUTE SETTLEMENT

8.1 Dispute settlement may be initiated by the **Provider** or the **Recipient** or the (*the entity designated by the Governing Body*), acting on behalf of the **Governing Body** of the **Treaty** and its **Multilateral System**.

8.2 The parties to **this Agreement** agree that the (*the entity designated by the Governing Body*), representing the **Governing Body** and the **Multilateral System**, has the right, as a third party beneficiary, to initiate dispute settlement procedures regarding rights and obligations of the **Provider** and the **Recipient** under **this Agreement**.

8.3 The third party beneficiary has the right to request that the appropriate information, including samples as necessary, be made available by the **Provider** and the **Recipient**, regarding their obligations in the context of **this Agreement**. Any information or samples so requested shall be provided by the **Provider** and the **Recipient**, as the case may be.

8.4 Any dispute arising from **this Agreement** shall be resolved in the following manner:

a) Amicable dispute settlement: The parties shall attempt in good faith to resolve the dispute by negotiation.

b) Mediation: If the dispute is not resolved by negotiation, the parties may choose mediation through a neutral third party mediator, to be mutually agreed.

c) Arbitration: If the dispute has not been settled by negotiation or mediation, any party may submit the dispute for arbitration under the Arbitration Rules of an international body as agreed by the parties to the dispute. Failing such agreement, the dispute shall be finally settled under the Rules of Arbitration of the International Chamber of Commerce, by one or more arbitrators appointed in accordance with the said Rules. Either party to the dispute may, if it so chooses, appoint its arbitrator from such list of experts as the Governing Body may establish

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arbitrator, or presiding arbitrator, as the case may be, from such list of experts. The result of such arbitration shall be binding.

ARTICLE 9 — ADDITIONAL ITEMS

Warranty

9.1 The **Provider** makes no warranties as to the safety of or title to the **Material**, nor as to the accuracy or correctness of any passport or other data provided with the **Material**. Neither does it make any warranties as to the quality, viability, or purity (genetic or mechanical) of the **Material** being furnished. The phytosanitary condition of the **Material** is warranted only as described in any attached phytosanitary certificate. The **Recipient** assumes full responsibility for complying with the recipient nation's quarantine and biosafety regulations and rules as to import or release of **genetic material**.

Duration of Agreement

9.2 This **Agreement** shall remain in force so long as the **Treaty** remains in force.

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ARTICLE 10 — SIGNATURE/ACCEPTANCE

The Provider and the Recipient may choose the method of acceptance unless either party requires this Agreement to be signed.

Option 1 –Signature*

I, David Bergvinson, represent and warrant that I have the authority to execute this Agreement on behalf of the Provider and acknowledge my institution's responsibility and obligation to abide by the provisions of this Agreement, both by letter and in principle, in order to promote the conservation and sustainable use of Plant Genetic Resources for Food and Agriculture.

Signature..... Date 26/9/2015

Name of the Provider: Dr David Bergvinson
Director General, ICRISAT

ICRISAT

I, J.D.M.V.P.S Shri S.S.P Arts BTTS Comm & G.R.P.S.R College Jalgaon. (*Full Name of Authorized Official*), represent and warrant that I have the authority to execute this Agreement on behalf of the Recipient and acknowledge my institution's responsibility and obligation to abide by the provisions of this Agreement, both by letter and in principle, in order to promote the conservation and sustainable use of Plant Genetic Resources for Food and Agriculture.

Signature.....

Name of the Recipient: Dr. L.P. Deshmukh
PRINCIPAL
Shri S. S. Patil Arts, Shri. T. T. Sahaney
Com. & Shri G. R. Pandit Science
JALGAON

Date 8/8/2018

Shri S.S.Patil Arts,Shri Bhausaheb T.T.Sahaney Comm. Shri G.R.Pandit Science College, Jalgaon J.D.M.V.P.S's Jalgaon

Option 2 – Shrink-wrap Standard Material Transfer Agreements*

The Material is provided conditional on acceptance of the terms of this Agreement. The provision of the Material by the Provider and the Recipient's acceptance and use of the Material constitutes acceptance of the terms of this Agreement.

Option 3 – Click-wrap Standard Material Transfer Agreement*

☐ I hereby agree to the above conditions.

* Where the Provider chooses signature, only the wording in Option 1 will appear in the Standard M... Agreement. Similarly where the Provider chooses either shrink-wrap or click-wrap, only the wording... Option 3, as appropriate, will appear in the Standard Material Transfer Agreement. Where the "click-... the Material should also be accompanied by a written copy of the Standard Material Transfer Agree...

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Annex I

LIST OF MATERIALS PROVIDED

This *Annex* contains a list of the **Material** provided under **this Agreement**, including the associated information referred to in Article 5b.

This information is either provided below or can be obtained at the following website: (*URL*).

The following information is included for each **Material** listed: all available passport data and, subject to applicable law, any other associated, available, non-confidential descriptive information.

(*List*)

RATE AND MODALITIES OF PAYMENT UNDER ARTICLE 6.7 OF THIS AGREEMENT

1. If a **Recipient**, its affiliates, contractors, licensees, and lessees, **commercializes a Product** or **Products**, then the **Recipient** shall pay one point-one percent (1.1 %) of the **Sales** of the **Product** or **Products** less thirty percent (30%); except that no payment shall be due on any **Product** or **Products** that:

(a) are **available without restriction** to others for further research and breeding in accordance with Article 2 of **this Agreement**;

(b) have been purchased or otherwise obtained from another person or entity who either has already made payment on the **Product** or **Products** or is exempt from the obligation to make payment pursuant to subparagraph (a) above;

(c) are sold or traded as a commodity.

2. Where a **Product** contains a **Plant Genetic Resource for Food and Agriculture** accessed from the **Multilateral System** under two or more material transfer agreements based on the Standard Material Transfer Agreement only one payment shall be required under paragraph 1 above.

3. The **Recipient** shall submit to the **Governing Body**, within sixty (60) days after each calendar year ending December 31st, an annual report setting forth:

(a) the **Sales** of the **Product** or **Products** by the **Recipient**, its affiliates, contractors, licensees and lessees, for the twelve (12) month period ending on December 31st;

(b) the amount of the payment due; and

(c) information that allows for the identification of any restrictions that have given rise to the benefit-sharing payment.

4. Payment shall be due and payable upon submission of each annual report. All payments due to the **Governing Body** shall be payable in (*specified currency*)[*] for the account of (*the Trust Account or other mechanism established by the Governing Body in accordance with Article 19.3f of the Treaty*).[**]

[*] *Note by the Secretariat*: The Governing Body has not yet considered the question of currency of payment. Until such decision, Standard Material Transfer Agreements should specify United States dollars (US$).

[**] *Note by the Secretariat*: This is the Trust Account provided for in Article 6.3 of the Financial Rules, as approved by the Governing Body (*Appendix E* to this Report). The details of the Trust Account when established, will be inserted here, and communicated to Contract Parties.

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TERMS AND CONDITIONS OF THE ALTERNATIVE PAYMENTS SCHEME UNDER ARTICLE 6.11 OF THIS AGREEMENT

1. The discounted rate for payments made under Article 6.11 shall be zero point five percent (0.5 %) of the Sales of any **Products** and of the sales of any other products that are **Plant Genetic Resources for Food and Agriculture** belonging to the same crop, as set out in Annex 1 to the Treaty, to which the **Material** referred to in *Annex 1* to **this Agreement** belong.

2. Payment shall be made in accordance with the banking instructions set out in paragraph 4 of *Annex 2* to **this Agreement.**

3. When the **Recipient** transfers **Plant Genetic Resources for Food and Agriculture under Development**, the transfer shall be made on the condition that the **subsequent recipient** shall pay into the mechanism established by the **Governing Body** under Article 19.3f of the **Treaty** zero point five percent (0.5 %) of the Sales of any **Product** derived from such **Plant Genetic Resources for Food and Agriculture under Development**, whether the **Product** is available or not without restriction.

4. At least six months before the expiry of a period of ten years counted from the date of signature of **this Agreement** and, thereafter, six months before the expiry of subsequent periods of five years, the **Recipient** may notify the **Governing Body** of his decision to opt out from the application of this Article as of the end of any of those periods. In the case the **Recipient** has entered into other Standard Material Transfer Agreements, the ten years period will commence on the date of signature of the first Standard Material Transfer Agreement where an option for this Article has been made.

5. Where the **Recipient** has entered or enters in the future into other Standard Material Transfer Agreements in relation to material belonging to the same crop[s], the **Recipient** shall only pay into the referred mechanism the percentage of sales as determined in accordance with this Article or the same Article of any other Standard Material Transfer Agreement. No cumulative payments will be required.

OPTION FOR CROP-BASED PAYMENTS UNDER THE ALTERNATIVE PAYMENTS SCHEME UNDER ARTICLE 6.11 OF THIS AGREEMENT

I *(full name of Recipient or Recipient's authorized official)* declare to opt for payment in accordance with Article 6.11 of this Agreement.

Signature: ..... Date: 2/8/2018

Dr. L. P. Deshmukh

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[b] In accordance with Article 6.11b of the Standard Material Transfer Agreement, the option for this modality of payment will become operative only once notification has been provided by the Recipient to the Governing Body. The signed declaration of option for this modality of payment must be sent by the Recipient to the Governing Body at the following address, whichever method of acceptance of this Agreement (signature, shrink-wrap or click-wrap) has been chosen by the Parties to this Agreement, and whether or not the Recipient has already indicated his acceptance of this option to accept the this Agreement itself:

The Secretary,
International Treaty on Plant Genetic Resources for Food and Agriculture
Food and Agriculture Organization of the United Nations
I-00100 Rome, Italy

The signed declaration must be accompanied by the following:

- The date on which this Agreement was entered into,
- The name and address of the Recipient and of the Provider,
- A copy of Annex 1 to this Agreement.

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INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A Brief Review On Nutritional Diversity In Pearl Millet Varieties

S.N. Patil[1,3]* & L. P. Deshmukh[2,4]

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[2]Department of Botany, J.D.M.V.P.S. Arts, Commerce and Science College, Jalgaon, 416702.MS, India.

Abstract:

Pearl millet, a hardy and versatile cereal, plays a crucial role in global food security. It thrives in arid and semiarid regions, making it an indispensable crop for resource-constrained areas. This review explores the rich genetic diversity of pearl millet varieties, their distribution, and adaptation to different environments, along with their historical and cultural significance. The nutritional composition section examines the macronutrient and micronutrient content of pearl millet, highlighting its role as a source of carbohydrates, proteins, fats, vitamins, minerals, dietary fibre, and antioxidants. This diversity in nutritional content makes pearl millet an attractive choice for improving diets and addressing malnutrition. Moreover, the review explores the implications of pearl millet's diverse nutrition for human health, including its potential to combat malnutrition and non-communicable diseases. In agriculture, it discusses the adaptability of different pearl millet varieties to various environments and the potential for breeding and crop improvement. Ultimately, this review underscores the importance of recognizing and harnessing the nutritional diversity within pearl millet varieties. It highlights the need for continued research and policy support to leverage this crop's potential in enhancing global food security and promoting healthier diets.

Keywords: Nutritional, Pearl millet, Diversity**.**

Introduction:

Pearl millet (Pennisetum glaucum) is a humble but remarkable cereal crop that has sustained human populations for centuries in regions plagued by challenging environmental conditions. Its endurance in arid and semiarid climates, coupled with its versatile nutritional attributes, renders pearl millet an invaluable staple crop. This introduction sets the stage for our comprehensive review, emphasizing the multifaceted significance of pearl millet as a critical component of global agriculture and diets.

Pearl Millet as a Staple Crop: Throughout history, pearl millet has been the cornerstone of food security for millions of people across Africa, Asia, and the Americas. Its cultural and historical importance extends beyond mere sustenance, weaving itself into the fabric of societies that have thrived amidst adversity [7,12]. As a hardy, drought-resistant cereal, pearl millet stands as a symbol of resilience, offering sustenance when other crops falter in the face of unpredictable rainfall and resource limitations. The deep-rooted traditions of pearl millet consumption resonate with its enduring adaptability and reliability, earning it the epithet of a "poor man's crop" that enriches diets and livelihoods alike[23].

Understanding Nutritional Composition for Food Security and Human Health: While pearl millet's resilience is laudable, its significance transcends the mere provision of calories. The nutritional profile of this cereal is a treasure trove of macronutrients and micronutrients, delivering a substantial portion of essential dietary components[26,27]. Pearl millet is not merely a subsistence crop; it is a nutritional powerhouse. To fully harness its potential and address global food security and health challenges, a profound comprehension of the nutritional composition is indispensable. Variations in macronutrients, micronutrients, dietary fiber, and antioxidants among different pearl millet varieties hold the key to designing diets that not only satisfy hunger but also promote well-being[15,37].

The Importance of Recognizing Nutritional Diversity in Pearl Millet Varieties: Recognizing the nutritional diversity within pearl millet varieties is not merely an academic exercise; it is an essential step in harnessing the full potential of this remarkable cereal crop for global food security and health[3,4]. This diversity offers a multitude of benefits, as it caters to the specific nutritional needs and challenges faced by different communities and regions worldwide. The rich array of macronutrients, micronutrients, dietary fiber, and antioxidants within pearl millet varieties can address various nutritional deficiencies and combat the rising tide of non-communicable diseases. By appreciating and utilizing this diversity, we unlock a treasure trove of solutions that can transform diets and improve well-being on a global scale. The nutritional diversity in pearl millet empowers us to tackle malnutrition and its devastating consequences. By emphasizing the protein content in one variety to combat protein-energy malnutrition and promoting an iron-rich variety to address iron-deficiency anaemia, we can make significant strides in improving the health of vulnerable populations. This crop provides an avenue for sustainable nutrition interventions, especially in regions where access to a diverse diet is limited. Moreover, the versatility of pearl millet in various culinary applications means it can be seamlessly integrated into local diets and cultural preferences. Recognizing the adaptability of pearl millet to diverse agricultural environments, including arid and semi-arid regions, strengthens its role in promoting food security and reducing vulnerability to climate-related challenges[9,10,11]. The Future of Pearl Millet Research and its Potential Impact: The future of pearl millet research is promising and holds the key to transformative change in global food security and health. Researchers, policymakers, agricultural scientists, and nutritionists are poised to work collaboratively to unlock the full potential of this versatile crop. By enhancing breeding programs to develop improved varieties and by promoting sustainable agricultural practices, we can increase production and availability. Through dietary education and awareness campaigns, nutritionists can highlight the diverse nutritional advantages of pearl millet, thus encouraging its inclusion in balanced diets. Policymakers play a crucial role in creating an enabling environment that supports pearl millet production, marketing, and distribution. The impact of pearl millet on global food security and health is substantial. As we move forward, pearl millet has the potential to alleviate malnutrition, reduce the prevalence of non-communicable diseases, and provide a reliable source of sustenance in the face of climate change. By recognizing the significance of nutritional diversity within pearl millet varieties, we embark on a journey towards a more nourished, secure, and sustainable future. This crop, with its diverse and nutritious qualities, has the potential to make a significant and lasting impact on the well-being of people across the globe. It is a testament to the power of a humble crop to address some of the world's most pressing challenges [1,5,7,8].

Objectives and Structure of the Review: This review embarks on a comprehensive exploration of the nutritional diversity within pearl millet varieties, unravelling the genetic, cultural, and dietary tapestry of this extraordinary crop. Our objectives are threefold:

Varietal Diversity: We will delve into the diverse pearl millet varieties, examining their geographic distribution, adaptation to distinct climates, and their historical and cultural significance. This section will unveil the array of genetic diversity that contributes to the adaptability and uniqueness of pearl millet.

Nutritional Composition: The heart of this review lies in the analysis of the nutritional composition of pearl millet. We will delve into the macronutrient content, encompassing carbohydrates, proteins, and fats, and explore the intricacies of micronutrients, vitamins, minerals, dietary fiber, and antioxidants in various varieties. By doing so, we aim to highlight how this diversity empowers pearl millet as an instrument for improved nutrition and health.

Implications for Food Security and Health: With a solid understanding of the nutritional diversity, we will delve into the implications for food security and human health. We will explore how pearl millet, enriched with diverse nutrients, can combat malnutrition, address non-communicable diseases, and support overall well-being. Additionally, we will discuss the significance of pearl millet in agricultural sustainability. In the following sections, we will traverse through these objectives, unearthing the riches of pearl millet and shedding light on its profound implications for global food security and the health of millions. Understanding and harnessing this diversity will not only enrich diets but also empower communities to thrive in the face of challenges, both environmental and nutritional.

A) Various Pearl Millet Varieties and Their Adaptations: Tall Pearl Millet (Pennisetum glaucum subsp. glaucum) Geographic Distribution: This variety is widespread in tropical and subtropical regions across Africa, Asia, and the Americas.

Adaptation to Climate: Tall pearl millet is well-suited to hot and arid regions with sporadic rainfall. Its tall stature allows it to access moisture from deeper soil layers.

Dwarf Pearl Millet (Pennisetum glaucum subsp. monodii):

Geographic Distribution: Primarily found in West Africa and India, particularly in the arid Sahel region.

Adaptation to Climate: Dwarf pearl millet thrives in areas with limited rainfall and is less prone to lodging, making it ideal for regions with strong winds and unpredictable weather.

Broomcorn Millet (Pennisetum glaucum subsp. typhoideum):

Geographic Distribution: Predominantly cultivated in Asia, especially in China and the Himalayan region.

Adaptation to Climate: Broomcorn millet is suited to temperate and high-altitude areas, where it can withstand cooler temperatures and shorter growing seasons.

Finger Millet (Eleusine coracana):

Geographic Distribution: Not a variety of pearl millet but closely related, finger millet is grown in Africa and parts of Asia, particularly in highland regions.

Adaptation to Climate: Finger millet is adapted to high-altitude regions and cooler climates.

Hybrid Pearl Millet Varieties: Created through breeding programs, hybrid pearl millet varieties often exhibit improved traits such as disease resistance, higher yield, and grain uniformity.

These hybrids can adapt to a wide range of climates depending on the specific hybrid and breeding objectives.

Landrace Varieties: Many regions have developed their own landrace pearl millet varieties over generations, suited to local environmental conditions and cultural preferences.

Historical and Cultural Significance:Pearl millet varieties have played a vital role in the cultural and historical tapestry of the regions where they are grown. They are often associated with traditional customs, local cuisines, and celebrations. These crops have offered sustenance in times of scarcity and have been a symbol of resilience in the face of harsh environmental conditions. For example, in many parts of Africa, pearl millet is a staple in daily meals, and its grains are used to make porridge, bread, and alcoholic beverages. The crop is often a crucial component of cultural rituals and ceremonies, symbolizing fertility and prosperity[36,41,42].

B) Genetic Diversity and Breeding Efforts:

The genetic diversity among pearl millet varieties is substantial. Traditional farming practices and adaptations over centuries have led to unique local varieties. Researchers and breeders have recognized the potential of this diversity in addressing food security challenges and enhancing agricultural sustainability. Efforts in pearl millet breeding have aimed at developing improved varieties with traits such as drought resistance, pest and disease resistance, and higher grain yields[2,13,14]. These breeding programs often involve the incorporation of traits from different pearl millet varieties, including landrace and hybrid varieties. Genetic diversity studies are ongoing to identify valuable traits within various pearl millet varieties, paving the way for targeted breeding efforts. These endeavours' acknowledge the historical and cultural importance of pearl millet while also harnessing its genetic potential to meet the agricultural and nutritional needs of the present and future. In summary, pearl millet varieties are diverse and adaptable, serving as a testament to human ingenuity in breeding and cultivation[28,32]. Their historical and cultural significance is intertwined with the resilience of

communities in challenging environments. The ongoing genetic diversity studies and breeding efforts are crucial for unlocking the full potential of pearl millet as a staple crop in addressing global food security and agricultural sustainability[16,17].

C) Macronutrient Content: Pearl millet (Pennisetum glaucum) is a versatile cereal known for its rich macronutrient content. Different pearl millet varieties exhibit variations in their macronutrient composition, which is essential for human nutrition. **Carbohydrates**: Pearl millet is primarily composed of carbohydrates, accounting for about 65-75% of its dry weight. Carbohydrates in pearl millet mainly consist of starch, which provides a readily available source of energy. The carbohydrate content can vary among different varieties, and some may have a higher starch content than others. **Proteins**: Pearl millet is a good source of plant-based proteins, containing around 8-12% protein content in its grains. The protein content in pearl millet is higher than that of many other cereals like maize and sorghum. These proteins are important for tissue repair and growth, making pearl millet a valuable dietary component, especially in regions where animal protein sources are scarce Fats: Pearl millet is relatively low in fat, with fat content typically ranging from 3-8% of the grain's dry weight. The **fats** in pearl millet are mostly unsaturated fats, which are considered heart-healthy. While the fat content is not exceptionally high, the composition of fats in pearl millet contributes to its nutritional value[18,19,20].

D) Micronutrient Content: Pearl millet also contains a range of essential micronutrients, including vitamins and minerals. Vitamins: Pearl millet is a good source of various B-vitamins, particularly niacin (vitamin B3) and pyridoxine (vitamin B6). These vitamins play crucial roles in energy metabolism, nervous system health, and overall well-being. The content of these vitamins can vary among pearl millet varieties, with some being particularly rich sources. Minerals: Pearl millet is rich in essential minerals such as magnesium, phosphorus, and iron. Magnesium is important for muscle function and bone health, while phosphorus is vital for the formation and maintenance of bones and teeth. Iron is crucial for the formation of haemoglobin and the prevention of anaemia. Pearl millet's mineral content can vary depending on the variety and the soil conditions in which it is grown. Dietary Fiber: Pearl millet is an excellent source of dietary fiber, with some varieties containing higher levels of fiber compared to other cereals[29,30,31]. Dietary fiber is essential for digestive health, as it promotes regular bowel movements and can help prevent constipation. It also contributes to a feeling of fullness and can aid in weight management. The fiber content in pearl millet is predominantly in the form of insoluble fiber, which adds bulk to the stool and supports digestive regularity. Antioxidant Properties: Pearl millet contains antioxidants, such as phenolic compounds and flavonoids, which can help protect cells from oxidative damage caused by free radicals. These antioxidants play a role in reducing the risk of chronic diseases like heart disease and cancer. The antioxidant content in pearl millet can vary among varieties, with some exhibiting higher levels of these beneficial compounds. In summary, pearl millet offers a diverse array of macronutrients and micronutrients, making it a valuable dietary component in many regions[21,22]. The variation in nutritional composition among different pearl millet varieties allows for a range of options to suit the dietary and nutritional needs of diverse populations. The cereal's high dietary fiber content and antioxidant properties further contribute to its significance as a nutritious and health-promoting grain, supporting both food security and human health. Understanding these nutritional attributes is vital for maximizing the benefits of pearl millet in diets and addressing nutritional challenges[24,25].

E) Health Benefits of Consuming Pearl Millet with Diverse Nutritional Compositions: Pearl millet (Pennisetum glaucum) with its diverse nutritional compositions offers a multitude of health benefits, making it a significant dietary component for various populations. Below, we explore these health advantages and discuss the role of pearl millet in addressing malnutrition and non-communicable diseases. Additionally, we highlight specific medicinal or therapeutic properties attributed to particular varieties[24,25].

I. Nutrient-Rich and Energizing: Pearl millet is a nutrient-dense cereal. Its carbohydrates provide a quick and sustained source of energy, making it an ideal choice for active individuals. Consuming pearl millet varieties rich in proteins can help in muscle repair and growth, making it beneficial for those who are physically active or engaged in physical labour.

II. Malnutrition Mitigation: Malnutrition, especially in the form of protein-energy malnutrition, is a significant concern in many regions. Pearl millet, with its higher protein content compared to other cereals, can play a crucial role in mitigating protein malnutrition. The diverse amino acid profile in pearl millet makes it complementary to other plant-based proteins, helping in the creation of a balanced diet.

III. Iron and Anemia Prevention: Iron deficiency anemia is a global health issue. Pearl millet, with its substantial iron content, can contribute to preventing and addressing this condition. The absorption of non-heme iron (the form of iron found in plant-based foods) can be enhanced when consumed with foods rich in vitamin C, such as fruits and vegetables.

IV. Magnesium for Muscle and Bone Health: Pearl millet is a notable source of magnesium. This mineral is vital for muscle function and bone health. Consuming pearl millet can aid in muscle relaxation, reducing the risk of muscle cramps, and supporting bone strength.

V. Antioxidant Protection: Pearl millet, especially varieties with high antioxidant content, can protect cells from oxidative damage due to free radicals. The consumption of antioxidants is associated with a reduced risk of chronic diseases, such as heart disease and certain types of cancer.

VI. Weight Management. The dietary fibre in pearl millet, particularly in varieties with higher fiber content, can promote a feeling of fullness and reduce overeating. A diet rich in fiber can support weight management efforts and help prevent obesity.

VII. Digestive Health: The insoluble fiber found in pearl millet adds bulk to stool, promoting regular bowel movements and preventing constipation. Pearl millet's fiber content can contribute to digestive health and help maintain gastrointestinal regularity.

VIII. Heart Health: Some pearl millet varieties with a balanced nutritional composition can support heart health. The cereal's low-fat content and high fiber content can contribute to lower cholesterol levels. Reducing cholesterol and maintaining a healthy weight are factors in the prevention of heart disease.

IX. Diabetes Management: The complex carbohydrates in pearl millet are digested slowly, resulting in a gradual increase in blood sugar levels. Consuming pearl millet can help stabilize blood sugar levels, making it beneficial for individuals with diabetes or those at risk of developing the condition.

X. Potential Medicinal and Therapeutic Properties of Specific Varieties: Some pearl millet varieties have been traditionally used for their medicinal properties in various cultures. For instance, certain varieties have been employed in traditional medicine to treat digestive disorders, including diarrhoea. The leaves and grains of pearl millet are used for their potential therapeutic properties in Ayurvedic medicine. For example, they are considered cooling and diuretic, potentially beneficial for managing conditions like urinary tract infections and heat-related illnesses[,33,38,39,40].

F) Challenges in Promoting Diverse Pearl Millet Varieties: Lack of Awareness: Many people, especially in urban areas, are not familiar with pearl millet and its diverse varieties. This lack of awareness can hinder its promotion and consumption. Preference for Modern Crops: In many regions, there is a preference for modern cereal crops like rice and wheat. Promoting pearl millet varieties may face resistance due to cultural and dietary habits. Supply Chain Issues: Inadequate infrastructure and supply chain support can make it difficult for farmers to cultivate and distribute diverse pearl millet varieties. This limits their availability in the market.

Genetic Erosion: The shift towards monoculture and hybrid varieties can lead to genetic erosion, where traditional and diverse pearl millet varieties are at risk of disappearing[34,35].

Conclusion and Summary:

Pearl millet's adaptability to arid and semi-arid regions contributes to sustainable agriculture, especially in regions prone to climate change and water scarcity. By providing a reliable source of nutrition in such areas, pearl millet can reduce food insecurity and the risk of malnutrition. In conclusion, the consumption of diverse pearl millet varieties offers a plethora of health benefits. From providing essential nutrients to preventing malnutrition and addressing non-communicable diseases, pearl millet serves as a valuable dietary staple in many regions. Additionally, specific pearl millet varieties, with their medicinal and therapeutic properties, have been integral to traditional healing practices. Recognizing the nutritional and medicinal potential of pearl millet is essential for harnessing its benefits, improving global food security, and promoting human health and well-being.

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