A Study on Agriculture of Millet Crop

[1]Hiran Das Mahar, [2]Durgesh Mahar, [3]Divya Mahar

[1]HOD Botany RG PG College Ambikapur Chhattisgarh, India.
[2]Research Student DAVV Indore MP India
[3]Tech.Lab. FSSAI Hyderabad, Telangana, India

***Abstract*- Millet is a common term for categorizing small-seeded cereal, of the grass family, that are often called Nutri -cereals. Govt. of India and CG promoted the Shree Crop Project in the International Millet Year 2023. Higher Education Universities and Agriculture are interested in studying Millet crops. In this paper, the Distribution, Taxonomy, of kodo (*Paspalum scrobiculatum,*) and Kutakee (*Panicum sumatrense*) types of millets, Nutritional Value, and significance are studied and the disease is discussed for precaution.**

***Key Words*: Shri Anna, Millet Year2023, Kodo – Kutakee, Millet food, Sugar free crops.**

INTRODUCTION:
Kodo *(Paspalum scrobiculatum,*) and Kutakee (*Panicum sumatrense*) were food of poors before 60 years. But when famine took place in the decade of 1970-80 .Millets were used even by rich farmers. There was a phrase: "Sukh me chayoor dar. Bipati me kodayi. Nichat me paraan rakhe Mahuwa Sarayi." Means, in wealthy time eating rice – pulse – veg., and in famine eat millet. While, at starving, *Madhuka* flowers and boiled Sal seed (*Sorea robusta*) were eaten. Those time millet flour and crushed wheat (Dalia) were imported to combat with famine. Millet was 40 to 50% cheaper than Rice in those days and it was suggested as food of poor, because, It was grown on plane land needing not stagnant water. While, quality rice need deep watery field for agriculture. [1]
Pharmaceutical and biochemical study of millets in twenty first century brought a revolution that it millet is best food for anti sugar properties and anti ageing factors. It is more easily digestive and good for patients and it is also good for healthy people to prevent from diseases. [2, 3]
Objective of this study is the survey of millet agriculture and its taxonomy, nutritional value, pharmacological significance and millet diseases.

METHODOLOGY: Exploration was made for the millet crop in the agricultural fields in Surguja district of Chhattisgarh State in India. The survey was done on 27 August 2023 and a plot of Millet cropping was observed at the RMD Agricultural College field. It co-ordinates with 23.137761 ^{0} E and 83.192956 ^{0}N. The plant samples of nine varieties of millet crop were collected, Morphology and Taxonomy of their vegetative and floral part were done in the lab using dissecting microscope.

Identification of Millets:
Class: **Monocotyledon:** Linear leaves, trimerous lower, adventitious roots and one cotyledon.
Series : Glumiflorae : Bracts scaly and conspicuous and Two perianth reduced to lodicules.
Family : **Poaceae (Graminae):**
Habit : Annual to perennial herb.**;Leaves:** Alternate, Ligullate, Distichous, long linear blade, and sheath present at the base.**Inflorescence:** Spike of spikelets.
Flower: Flowers are Sessile, Bisexual, Zygomorphic, and hypogynous.
Lower bract is called Lemma and upper two bracts called Pallea.
Perianths: Flowers enclosed by two scales called Glumes, two Lodicules of reduced perianths.
Androecium: Number of Stamen 3+3, Free and versatile.
Gynoecium: Unicarpilary, unilocular, basal placentation , Style two and sigma feathery.
Fruits: Caryopsis Seeds Endospermic Single cotyledon at germination called Scutellum.
Sub family: **Penicoidae:** Fruits round Achene. Plant s of fertile and it is dry land crop.

TYPE OF MILLETS : There are nine kinds of millets cultivated across various regions in India. Figure1 represents kodo millet, figure2 represents little millet, figure 3 represents foxtail millet , figure 4 represents finger millet. Furthermore, sorghum millet is depicted in figure5, *Avena sativa* (Oat-millet) is depicted in figure6, barnyard millet**.** is depicted in figure7, Pearl millet is depicted in figure8 and lastly figure9 represents proso millet. These vary in color, size and texture, but share roughly the same nutritional profile. And all of them have local names in many Indian languages, attesting to their historical popularity across regions. Table1 represents the type of millets with their morphological and nutritional characteristics, and table 2 represents pathology on Millet crops.[4, 5]

Figure1 Kodo millet

Figure2 Kutki Millete

Figure3 Fox Tail Millet

Figure4 Fingure Millet

Figure5 *Hordium vulgare*

Figure6*Avena sativa*

Figure7 *Echinochloa esculenta* .

Figure8 Pearl millet

.Figure.9 Proso millet

Table1 Types of millets and their characteristics:

Srl N^0	**Hindi Name**	**English Name**	**Botanical Name**	**Fig N^0**	**Plants Height**	**Morphological Specificity**	**Size of Seed**	**Nutrition mg/100gram**
1	kodo	kodo millet	***Paspalum scrobiculatum,***	1	0.5-1m	Dry land farming	4mm-6mm	iron=0.5mg calcium,= 27mg
2	Kutki	little millet	*Panicum sumatrense*	2	0.25cm 0.75m	Dry land farming	2mm-4mm	Ca=17mg Fe=9.3mg
3	kakun	foxtail millet	*Panicum italicum*	3	0.5m-0.75m	Moderate land	2mm-4nm	Fe=2.8 mg Zinc=2.4mg
4	Ragi	finger millet	*Eleusine coracana*	4	0.25m-0.5m	Dryland farming	2mm-4mm	Fe=11.3mg Na=2mg Zn=1.7mg
5	Jwar	sorghum	*Hordium vulgare*	5	1m-2m	Moderate land	5mm-25mm	Fe=2mg Cu=2.5mg Zn=1.8 mg

6	Oat	Avena	*Avena sativa*	6	0.5m-4m	Dry land farming	1.5mm-2mm	Fe=5mg Na=2mg Zn=4mg
7	sawa	barnyard millet	*Echinochloa esculenta*	7	1m-2m.	Hydrophyte	4mm-8mm	Ca=17mg Fe=9.3mg
8	Bajra	Pearl millet	*Cenchrus americanum (P. glaucum)*	8	1m-2m	Dry land farming	2mm-5mm	Ca=4.2mg Fe=0.8mg
9	Cheena	proso millet	*Panicum miliaceum*	9	0.25-0.5m	Moderate land	2mm-3mm	Ca=27mg Fe=0.5mg

Table2 : Pathology of Millet Crop.

Sr. No.	Disease	Millet Host	Causal Organism	Survival	Effected Host Part	Symptom
1	Grain mold	Sorghum, Pearl millet, Finger millet	Curvularia lunata, Alternaria alternate, Phoma sorghina, Bipolaris spp.,	Crop residues, soil;	Inflorescence	Overgrowth and damaged fruits.
2	Sugary disease/ Ergot	Sorghum, Pearl millet	Claviceps sorghi, C. Africana C. fusiformis	Sclerotia in seed & soil, collateral host	Infected panicle, sclerotia in seed	Exudation of viscous droplet from infected florets
3	Smut	Sorghum, Small millets	Sporisorium reilianum Sporisorium sorghi Sporisorium cruenta	Soil-borne; externally seed-borne;	Plants stunted, thin-stalked and flower earlier	All spikelet's in a Panicle get malformed. empty spikelet
4	Long smut	Pearl millet	Tolyposporium penicillariae	Teleutospore in infected seed or in soil;	Plant and Inflorescence	The sorus is larger than grain and appears as enlarged body in place of grain
5	Grain smut	Finger millet Fox tail millet: Barnyard Kodo & Proso millet.	Melanopsichium eleusinis Ustilago crameri Sorosporium paspali-thunbergii.	Parenting in seeds and soil	Inflorescence	The initial greenish color of sorus gradually turns pinkish green and finally to dirty black on drying.
6	Udbatta	Foxtail, Kodo & Little millet	Ephelis oryzae	Secondary hosts:Cynadon Pennisetum and Ergostis	Leaves and inflorescence	The affected panicle is compact, silver colored, cylindrical spike that looks like an incense stick
7	Downy mildew /Crazy top	Sorghum, Pearl millet, Small millets	Peronosclerospora sorghi	Survive as oospores in host tissues and soil;	Leaves and inflorescence	Seedlings are pale yellow or have light-color streaking and may die prematurely.
8	downy mildew	Pearl millet	Sclerospora graminicola	oospores in host tissues and soil;	Leaves and inflorescence	Leaves stem and inflorescence got effected
9	Finger millet blast	Pearl millet, Finger, Foxtail, Barnyard, Proso & Little millets	Pyricularia grisea (Perfect state: Magnaporthe grisea)	the crop residues. Initial inoculums comes from weeds.	Leaves and Inflorescence	Adjoining spots may coalesce to give a blighted appearance on the leaf. A black dot like acervulus is often seen at the centre of the necrotic spot,
10	Rust	Sorghum, Pearl millet, Small millets	Puccinia purpurea	Survives on raton or grown sorghum, collateral hosts.	Two types of spores in the pustules on Sorghum viz., uredospore ,	Reddish brown pustules first on both the surfaces of the lower leaves. Generally the upper half of the leaf gets more severe infection than

					teleutospore.	the lower
11	Leaf Blight	Sorghum, Small millets Kodo millet: Alternaria spp.	Exserohilum turcicum. Perfect state: Trichometasphaeria turcica)	Persists as mycelia and conidia in the infected crop residues or in the soil;	Long, elliptical and necrotic lesions on the Leaf	Centre of the lesion is straw-color and the Margin is usually dark brown.
12	Leaf spot	Sorghum, Pearl millet, Small millets	Helminthosporium	Crop residues, collateral hosts and may be seed-borne;	Spots on leaf,	Leaf spots on sorghum appear as oval to cylindrical, rectangular spots.
13	Banded sheath blight	Finger, Foxtail, Barnyard, Proso, Kodo & Little millets	Rhizoctonia solani	Sclerotia attached with host tissue in soil,	Leaf sheath	Banded sheath blight , sclerotia can be observed on and around the lesion
14	Bacterial leaf spot	Sorghum, Pearl millet, Finger millet	Pseudomonas syringae , Xanthomonas eleusinae	Survives on crop residues in soil;	Leaves	Elliptical or irregular shaped spots with straw color center and dark margin.
15	Mosaic virus	Maize , Sorghum, Pearl millet and Finger millet	Maize stripe virus Maize mosaic virus Maize dwarf mosaic virus, Ragi mottle streak virus	Mechanically by sap; Aphid	Leaves	Mosaic followed by necrotic, red stripe and temperature dependent red leaf and general necrosis in sorghum

NTRITIONAL VALLUE:

Millets are nutritionally superior to wheat and rice owing to their higher protein levels and a more balanced amino acid profile. Millets also contain various phyto chemicals which exert therapeutic properties owing to their anti-inflammatory and anti-oxidative properties. Further, besides being climate resilient, millet grains are rich sources of nutrients like carbohydrates, protein, dietary fiber, and good-quality fat**;** Minerals like calcium, potassium, magnesium, iron, manganese, zinc and B complex vitamins. Most importantly, millet production is not dependent on the use of chemical fertilizers [6]

Kodo millet is a nutritious grain and a good substitute to rice or wheat. The grain is composed of 11% of protein, providing 9 grams/100 g consumed.[18] It is an excellent source of fibre at 10 grams (37-38%), as opposed to rice, which provides 0.2/100 g, and wheat, which provides 1.2/100 g. An adequate fiber source helps combat the feeling of hunger. Kodo millet contains 66.6 g of carbohydrates and 353 kcal per 100 g of grain, comparable to other millets. It also contains 3.6 g of fat per 100 g. It provides minimal amounts of iron, at 0.5/100 mg, and minimal amounts of calcium, and 27/100 mg. Kodo millets also contain high amounts of polyphenols, an antioxidant compound.[7].

Millets are less expensive and nutritionally **superior** to wheat & rice owing to their high protein, fiber, vitamins and minerals like iron content. Millets are also rich in calcium and magnesium. For example, Ragi is known to have the highest calcium content among all the food grains, and Millets can provide nutritional security and act as a shield against nutritional deficiency, especially among children and women. Its high iron content can fight high prevalence of anemia in India women of reproductive age and infants.

Gluten-free a low Glycemic Index: Millets can help tackle lifestyle problems and health challenges such as obesity and diabetes as they are gluten-free and have a low glycemic index (a relative ranking of carbohydrate in foods according to how they affect blood glucose levels).

SUPER CROP GROWING:

1 Millets are Photo-insensitive (do not require a specific photoperiod for flowering) and resilient to climate change. Millets can grow on poor soils with little or no external inputs.

2 Millets are less water consuming and are capable of growing under drought conditions, under non-irrigated conditions even in very low rainfall regimes.

3 Millets have low carbon and water footprint (rice plants need at least 3 times more water to grow in comparison to millet[7]

INTERNATIONAL YEAR OF MILLETS (IYM) 2023: Govt. of India have planned events in Ministry of Food Processing Industries which would be organizing Millet Fair-cum-exhibitions in Andhra Pradesh, Bihar and Madhya Pradesh; FSSAI will organize Eat Right Melas in Punjab, Kerala and Tamil Nadu , Chhattisgarh, Mizoram and Rajasthan are carrying out specific activities for sensitization and promotion of IYM. The states will be conducting millet centric activities including mahotsavs/ melas and food festivals, training of farmers, awareness campaigns, workshops/ seminars, placement of hoardings and distribution of promotional material at various key locations in the state, etc. Other states that are organizing similar activities include Maharashtra, Uttarakhand and Punjab.[8]

PATHOLOGY OF MILLET CROP :Table two represents pathology of millet crops at the glance. Many agricultural practices such as deep ploughing during summer season, cleaning of field bunds after crop season, removal of crop residues from the field, uprooting the diseased plant from the field and burning, regulating irrigation water from entering into other field, if followed regularly, reduce chances of disease occurrence.[9, 10]

1. Collateral and alternate hosts, weeds, volunteer and wild crop species harbor pathogen and serve as source of inoculums. Their timely removal helps to control diseases like ergot, downy mildew, rust, blast, leaf spots and bacterial and viral diseases.
2. Deep summer ploughing, destruction of crop residues and crop rotation with non-host plant help reducing inoculums of soil-borne diseases (downy mildew, smut, charcoal rot and a few fungal and bacterial leaf diseases).
3. Maintaining optimum plant spacing and regulating the amount of nitrogenous fertilizer reduces incidence of blast, downy mildew and charcoal rot.
4. Mechanical removal of sclerotia from seeds, by washing in 30% salt water reduces seed contaminated infection of ergot. In seed production plots, ensuring synchrony of flowering between A and R lines avoids the occurrence of ergot.
5. Management of smut diseases requires awareness among the farmers. Practice of clean cultivation like
6. Collecting smutted heads in cloth bags and dipping in boiling water to kill the pathogen will reduce the inoculums for the next year and minimize incidence.
7. Insect acts as vector for many viruses and injects virus inside the plant. Injury caused by insect in plants sometime help many bacteria to enter and cause disease. Insect control, therefore, helps in managing such diseases.
8. Resistant cultivar i.e. host-plant resistance provides the most economic and environment friendly method of managing millet diseases. For poor farmers it is the only viable practice, as they hardly use any other methods of disease control in millets.
9. For grain mold management use of a cultivar that escapes the disease is the best option. Use of mold tolerant cultivar (CSH16, CSH27, CSH30, CSV20 and PVK801) and harvesting the crop at maturity is the second best option to avoid grain deterioration and weathering.
10. Though high level of genetic resistance is not available against charcoal rot the present day cultivars viz., CSV19R, CSV216R and DSV6 possess good tolerance. Drought tolerant, lodging resistant and non-senescing Sorghum genotypes have good tolerance to charcoal rot.
11. All recently released cultivars of pearl millet (e.g., HHB 67, ICMH 356) possess tolerance to downy mildew as they are released only after multi-location testing.
12. Resistance sources against finger millet blast are rare in India and Nepal, and they need to be explored in land races from Africa. GPU 28 and GPU 48 is widely used cultivar highly resistant to neck and finger blast.
13. Barnyard millet genotypes PRB 402, TNAU 92 and VL 216 have resistance against the grain and head smut as well as brown spot diseases, while foxtail millet lines GPUS 27, SiA 3039, SiA 3059, SiA 3066, SiA 3088, TNAU 213 and TNAU 235 remain free from brown spot.
14. Biological control: Soil-borne diseases of millets (e.g., charcoal rot in sorghum, foot rot and sheath rot in small millets), for which adequate host resistance is lacking, use of bio control agents are useful. Seed treatment with talc formulation of Pseudomonas chlororaphis SRB127 reduces charcoal rot incidence and increase seed weight. Bio- control agents especially strains of Trichoderma and Pseudomonas are useful for foot rot and sheath rot in small millets.[11]
15. Chemical control: Chemicals are not generally used for disease management in millet, because of involvement of high cost of chemical and labor. However, sometimes its use in combination with resistant cultivar becomes necessary. Fungicides are mostly used either as seed treatment or foliar spray. However, combination of them gives better management.[12]
16. Downy mildew could be controlled by Seed treatment with Ridomyl-MZ @ 6g/Kg seed followed by one spray of Ridomyl-MZ @ 3g/L reduces incidence. Loose and covered smutn control needs Seed dressing with sulphur (@ 4g/Kg seed).Seed treatment with propiconazole (@ 1 ml/Kg seed).are effective for -

Banded sheath blight: Blast of millet could be controlled by Spraying Carbendazim (@ 0.1% a.i.) or Tricyclazole (@ 0.05% a.i.) or Combination of Mancozeb 63% + Carbenadzim 12% is recommended.[13]

17. Ergot could be cotroled by Use of tolerant cultivar and spraying panicles with fungicides (0.1% Bavistin or 0.2% Tilt or 0.2% Mancozeb) at flowering minimizes ergot incidence and its subsequent spread.[14]
18. For the control of Rust of millet, Foliar spray of Mancozeb @ 0.2% is effective. An insect vector could be controlled by spraying of Imidachlorprid @ 1.5 ml/ L is effectively reduce population of leaf hopper and decrease incidence of viral disease.[15]

CONCLUSION: Millet crops are needed less water and they are high nutritional value as well as, medicinal and anti ageing food. Their fore Millet crops should be grown and use in daily life,.

ACKNOWLEDGEMENT: Authors are thank full to Indian and CG state government to insist the study of Millet crops. Authors are also thankful to The Dean of Agriculture College Azirma, Ambikapur is For the visit and exploration of Millet crops.

DECLARATION: I Hiran Das Mahar, HOD Botany, RG PG College Ambikapur CG , the Correspondence Author of this study Declare that I have explored agricultural field and photographs art my own mobile camera. Secondly studied literature are properly cited in Reference, and at any critic, I take Personal responsibility.

REFERENCES:

1 https://www.soroptimistinternational.org/international-year-of-millets-2023/Retrieved on 01 October 2023.
2 https://currentaffairs.adda247.com/international-year-of-millets-2023/ International Year of Millets 2023 - Soroptimist International. Retrieved on 01 October 2023.
3 https://currentaffairs.adda247.com/international-year-of-millets-2023/ Retrieved on 01 October 2023.
4 International Year of millets 2023. https://www.fao.org/millets-2023/en; Retrieved on 10 October 2023.
5 I K Das: N Nagaraja; Vilash A Tonapi; DISEASES OF MILLET : PDF: ICAR Institute of Millet Research Raendranagaram HYDERABAD, 500030 (TS) WWW.millet.res.in Retrieved on 01 October 2023.
6 https://www.drishtiias.com/daily-updates/daily-news-analysis/international-year-of-millets-2 Retrieved on 10 October 2023.
7 https://www.bbc.com/travel/article/20230208-why-2023-is-the-year-of-millets Why 2023 is the year of millets. Retrieved on 10 October 2023.
8 'Chhattisgarh Millet Mission' Kodo-Kutki-Ragi https://www.jagranjosh.com/current-affairs/millet-mission-chhattisgarh-launches-millet- mission- Retrieved on 30 October 2023.
9 Vikaspedia:*https://vikaspedia.in/.../chhattisgarh-millet-mission*: Chhattisgarh Millet Mission — Vikaspedia; Retrieved on 10 October 2023.
10 SANGEETA NAIR: Millet Mission: Chhattisgarh launches new mission to become millet hub of India by, SEP 15, 2021, 13:15 IST: HTTPS://WWW.JAGRANJOSH.COM/CURRENT-AFFAIRS/MILLET-MISSION-CHHATTISGARH-LAUNCHES-MILLET-MISSION-TO-BECOME-MILLET-HUB-OF-INDIA-BY-2023-1631689155-1 Retrieved on 30 October 2023.
11 Bhawna Srivastava. Dayanand Anglo Vedic College, Kanpur.RECENT EXPLORATIONS ON MILLETS: THE NUTRI-CEREALS International Multidisciplinary Research Foundation, India September 2023. Publisher: International Multidisciplinary Research Foundation Ratna Prasad Multidisciplinary Research & Educational Society # 1-90, Near VTPS Main Gate, Brahimpatnam, Vijayawada, A.P., India ISBN: ISBN 978-93-90146-51-2 Retrieved on 30 October 2023.
12. https://cgmitan.com/the-greenery-of-kodo-kutki-spread-in-the-valleys-kodo-is-full-of-medicinal-properties/ Retrieved on 30 October 2023.
13 https://en.wikipedia.org/wiki/Echinochloa_esculenta Retrieved on 10 November 2023.
14 https://www.tropicalforages.info/text/entities/cenchrus_americanus.htm Retrieved on 30 November 2023.
15 https://www.bing.com/search?q=Panicum+miliaceum&form=CHRDEF&sp=-1&lq=0&pq=panicum+miliaceum&sc=1017&qs=n&sk=&cvid=5E5BDC67224C4FC2B4B34A1EBAA686D0&ghsh=0&ghacc=0&ghpl=. Retrieved on 10 December 2023.