



# HORSE GRAM: A POTENTIAL CLIMATE RESILIENT LEGUME FOR SUSTAINING FOOD AND NUTRITIONAL SECURITY.

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## INTRODUCTION

Horsegram (*Macrotyloma uniflorum*) is a legume species widely distributed in Indian subcontinent and an important supplement of dietary protein with medicinal effects. The genus *Macrotyloma* consists of 25 species, and most of them are wild except *Macrotyloma uniflorum* spp. *uniflorum*, which is cultivated in many parts of India. Horsegram is used as an important pulse crop since seeds are rich in protein and consumed in majority by poorest section of the society. Horsegram seeds are an excellent source of protein, carbohydrates, essential amino acids, energy, iron, molybdenum, phosphorus, iron and vitamin C. Its seeds are reported to be high in tannins and polyphenols as compared to other legumes and therefore considered as a good source of antioxidant. Despite nutritional advantages over other legumes, the crop is not grown commercially due to the presence of many undesirable traits in cultivated horsegram such as twining and indeterminate growth habit, long and thin stem and very late and non-synchronous maturity. Probable progenitor of cultivated horsegram is considered as *M. axillare*, which possesses many desirable traits such as higher number of seeds per plant and seed yield per plant and resistance against many pathogens, but due to non-compatibility with cultivated horsegram the traits cannot be transferred using conventional breeding strategies. The genome structure and organization of this crop are poorly understood, thereby limiting the effective use of gene resources for genetic improvement. being carried in this crop can be useful for future research work pertaining to construction of highly enriched genetic maps as well as development of drought-resistant and high-yielding varieties. It is not as popular as lentil, black gram, red gram and green gram, but is still one of the most nutritious legumes. Known by several regional names, the kulthi bean, hurali or

Madras gram was also common food for horses and cattle. Horse gram is the most protein-rich found on the planet. It is high-powered and hence used as feed for horses before races. The US National Academy of Sciences has identified this legume as a promising food source for the future. This legume seems to have been domesticated during the 2nd millennium BCE, according to researchers at University College, London. Its remarkable ability to thrive in parched environments makes the horse gram shrub a highly capable candidate, to meet food and nutritional requirements in malnourished populations. It is a legume that grows and propagates in arid regions, such as in the drylands in southern, central and northern parts of tropical countries namely India, Sri Lanka and Malaysia. It is a climbing herb, having leaves with tiny leaflets in triplets and white coloured flowers. The short and slender stem, upon maturing and developing, bears flattened small seeds that are red, brown or black and resemble the shape of a curved beak.

This minute natural seed offers some marvelous advantages for overall well-being, being densely packed with vital nutrients. Horse gram, besides being intrinsically vast in carbohydrate and protein content, also abounds in essential trace minerals like iron, molybdenum and calcium. These ensure optimal energy, muscle strength, regulated red blood cell synthesis and fortified bones. Moreover, it also supplies ample amounts of the B vitamins that guarantee the normal metabolic functioning of cells. Hence, it comes as no surprise that horse gram is being widely consumed globally today, in the form of the sprouted or boiled seeds, as a health drink made with the ground powder, as well as in traditional Indian dishes like dals, soups and salads.

Thus, this article highlights the global importance of horse gram in terms of its food value, nutraceutical features, and other benefits and its importance for improving soil quality, maintaining agroecological



systems, and providing feed and forage for livestock sustenance. I conclude the article by highlighting the importance of horse gram as a climate-resilient crop and its future scope as a dietary grain legume for sustaining global food security.

## ORIGIN AND DISTRIBUTION

Horse gram is native to South Asia. However, horse gram is presumed to originate from Africa, and the northwestern Himalayan region is considered the secondary center of origin. Relying on the evidence and assessing herbarium specimens, however, archaeobotanical evidence suggests it is of northwest Indian origin. The evidence suggests that it was cultivated and domesticated in south Deccan and northwest India. It is now cultivated in temperate and subtropical regions in India, the Philippines, Bhutan, China, Pakistan, Sri Lanka, and Australia.

### 1. Systematic Position and Botanical Description.

<b>Kingdom</b>	Plantae
<b>Phylum</b>	Tracheophyta
<b>Class</b>	Magnoliopsida
<b>Order</b>	Fabales
<b>Family</b>	Fabaceae
<b>Genus</b>	<i>Macrotyloma</i>
<b>Species</b>	<i>M. uniflorum</i>
<b>Chromosome No</b>	20, 22, 24

Plant habitat is climbing herb with stems upto 60 cm tall. It has a perennial fibrous rhizome. Stems are annual, sparsely to densely covered with spreading or appressed whitish hairs. Leaves are alternate, tri-foliolate, stipules lanceolate, 4-10 mm long, striated. Petioles are 1-7 cm long, rachis 2.5-10mm long, leaflets ovate-rhombic.

### Nutraceutical Benefits of Horse Gram

Horse gram is rich in protein (17.9–25.3%), carbohydrates (51.9–60.9%), and lipids (0.58–2.06%) and contains iron and molybdenum. It is used as whole seed and sprouts for human consumption and could be used as whole seed for cattle feed. Horse gram is an excellent source of carotene, thiamine, riboflavin, niacin, and vitamin C and several bioactive compounds, including phenolic acids, flavonoids, alkaloids, tannins, and antioxidants. The nutraceutical compounds can assist in curing various complex diseases, including urinary diseases, kidney stones, piles, coronary heart disease, diabetes.

### Horse Gram, a Climate-Resilient Crop Ensuring Global Food Security.

Horse gram is grown globally in temperate and subtropical countries as a cheap source of dietary protein. Being a leguminous crop, horse gram can help ameliorate soil nitrogen

and thus maintain agroecological systems. Moreover, it can survive water and salinity stress and can be grown on marginal land with low inputs due to its efficient antioxidant mechanisms, osmotic adjustment, and genetic and molecular mechanisms. Likewise, it can adapt to a wide range of temperatures where other crops fail to survive. The current urgency of global climate change and increasing human population is challenging for sustaining environments and global food security. Thus, breeding elite horse gram for frequent episodes of drought and heat stress is of great interest.

### Brief Description of Horse Gram Cultivation

The horse gram plants are very hardy and drought tolerant. They generally require less care and management. The horse gram plants grow well in almost all types of soil. But they prefer well-drained and fertile soil which is rich in lots of organic contents.

The plants are relatively tolerant to low to

moderate salinity levels with pH up to 8. They can grow in soil with heavy metal stresses, compared to other pulse crops grown in semi-arid regions. The horse gram plants are completely intolerant of frost and they are sensitive to becoming waterlogged.

### ► Land Preparation-

The horse gram plants grow well in well-drained and fertile soil which is rich in organic contents.

So while preparing the soil, till it first and then add as much organic contents as you can into the soil. Homemade compost, quick compost and well-rotted aged manure will be very good for using for this purpose. For commercial horse gram production, add at least 5-6 tonnes of organic contents per acre. And also add 60-65 kg of super phosphate and 20-22 kg of urea (nitrogen) per acre.

### ► Climate Requirements for Growing Horse Gram

The horse gram plants grow well in warm and dry climatic conditions. The plants are extremely drought tolerant and they require less care. Although the plants can't grow well on higher altitudes, mainly because of wet and cool climate (the plants can be grown up to an altitude of 1000 meter above the sea level). Relative humidity between 50 and 80 percent is optimum for the growth of these plants. And temperature ranging between 25 °C and 30 °C is ideal (the plants can tolerate up to 40 °C temperature, but the growth rate declines remarkably below 20 °C. For successful cultivation of horse gram, a well-distributed rainfall of about 800 mm is sufficient. Although the plants can perform very well even under low rainfall areas.

### ► Best Time for Growing Horse Gram

August-September is the best time for growing horse gram. But you should sow the seeds in the months of July-August if you want to grow horse gram as a fodder crop.



► **Choose a Variety**

. Some popular and widely cultivated horse gram varieties are; Arjia Kulthi-21, Baizu Kulthi, Birsa Kulthi-1, Hebbal Hurali-1 Hebbal Hurali-2, Madhu, VL Gahat 19 etc. These are the common and popular varieties of horse gram. Each different variety has its own different characteristics.

► **Purchase Quality Seeds**

The horse gram plants are grown from seeds. So after selecting your desired variety, purchase good quality seeds from any of your local suppliers. Always try to plant new seeds, and try to purchase the seeds from an authentic source.

► **Seed Rate-**

Exact amount of seeds depends on the variety. But on an average, you will need about 35 to 40 kg horse gram seeds per hectare.

► **Planting**

You can plant horse gram seeds either by scattering throughout the field or in rows. But I recommend planting horse gram seeds in rows, and it will make the caring process much easier. Exact spacing between rows and plants can vary depending on the selected varieties. But in most varieties, the rows should be about 30cm apart and the seeds should be sown at least 7.5-10cm apart. Remove the damaged or low quality seeds before sowing. Sow the seeds at about 1/2 to 3/4 inch deep. Soaking the seeds in fresh water for 24 hours will help the seeds to germinate well and faster. Water lightly immediately after sowing the seeds. And within a very few days, you will see the seedlings are coming out.

► **Caring for the Horse Gram Plants**

The horse gram plants are very strong and hardy. They generally require less care and management as compared to some other popular crops. Although taking additional care will help the plants to grow better and yield maximum. Here I am describing more about the caring process for growing horse gram plants.

► **Fertilizing:**

20 kg nitrogen and 30 kg P<sub>2</sub>O<sub>5</sub> per ha as basal application at the time of sowing is enough for good management of crop.

► **Controlling Weeds:**

Weeds consume nutrients from the soil. So controlling them is important. You can control weeds either by hands or by hoeing. But be very careful while hoeing, because the horse gram plants have very shallow roots.

► **Pests and Diseases**

The horse gram plants are susceptible to some common pests and diseases. Aphids, stem fly, leaf hopper and whitefly are some common pests. Common diseases of the horse gram are powdery mildew, cercospora, root rot wilt, leaf crinkle, leaf curl and mosaic virus.

► **Harvesting**

Harvest the matured whole plant, thresh the pods and then extract the seeds. Horse gram seeds generally become ready for harvesting when the pods in the plants turns from green to straw color. Avoid cloudy or rainy days for harvesting, and try to harvest when the sky is almost clear.

► **Yield**

It's actually very difficult to tell the yield, it depends on the variety and many other factors. But on an average, you can expect between 700 and 1000 kg per hectare.

## 2. Proposed agro-ecological zone based crop planning for promotion & self sufficiency in pulses in West Bengal

In table-1, it is very clear that Purulia, Hoogly, Jalpaiguri, Nadia and Howrah have very low productivity of pulses during both the years. It is also noted that all the districts have less area under pulse production. So, to increase the area, productivity and production throughout the state, horse gram is the best suitable pulse to achieve the self sufficiency.

**Table-1. District wise Area, Production and Productivity of pulses in West Bengal during 2019-20 & 2020-21.**

Sl No	District	2019-20			2020-21		
		Area in hectare	Yield in Kg per hectare	Production in tonnes	Area in hectare	Yield in Kg per hectare	Production in tonnes
1	Darjeeling	1569	759	1191	1152	928	1069
2	kalimpong	72	1167	84	65	1154	75
3	Jalpaiguri	6008	758	4556	5958	887	5287
4	Alipurduar	8968	917	8227	8625	849	7323
5	Coochbehar	10362	873	9044	10792	870	9393
6	Uttar Dinajpur	8635	767	6621	7690	915	7037
7	Dakshin Dinajpur	17206	832	14322	12411	948	11766
8	Malda	29443	1019	29988	27484	1011	27777
9	Murshidabad	86940	951	82700	82347	994	81890
10	Nadia	68862	666	45839	65411	799	52261
11	North 24 Parganas	21330	765	16312	22107	970	21450
12	South 24 Parganas	72502	377	27339	72336	924	66860
13	Howrah	3908	308	1205	4171	752	3137
14	Hoogly	4907	761	3735	5014	606	3040
15	Purba Bardhaman	15947	1073	17116	13812	1074	14830
16	Paschim Bardhaman	2755	954	2628	3180	932	2965
17	Birbhum	41940	1312	55005	42666	1047	44677
18	Bankura	11206	947	10614	11395	1015	11571
19	Purulia	23091	718	16570	24826	619	15362
20	Paschim Medinipur	13608	937	12747	12659	1149	14547
21	Jhargram	11423	840	9593	10529	1061	11173
22	Purba Medinipur	20351	899	18288	20829	1362	28364
Total		481033	818	393724	465459	949	441854

Source: Department of Agriculture, Government of West Bengal



### 3. MEDICINAL VALUES AND AYURVEDIC USES

Ayurveda strongly suggests several formulations where horse gram is used as a key ingredient for its indispensable medicinal value such as Kulathadhi kashaayam that has been used extensively in treating health anomalies. Being a hot-natured bean, horse gram can calm kabha and vatha dosha and increase rakta pitta kopaka dosha. Horse gram is a storehouse of polyphenols, flavonoids, and potent antioxidants that keep your body strong, The important medicinal values of horse gram and its ayurvedic uses are as follows-

#### a. Traditional Medicine

Horse gram powder does wonders in treating various health issues such as asthma, bronchitis, urinary problems, jaundice, peptic ulcer, haemorrhoids and even menstrual problems. It is also beneficial for extracting phlegm, and controlling fever.

#### b. Glowing Skin

The astringent properties of horse gram are helpful in treating skin disease leucoderma. It is also used as a facial pack to prevent skin problems and clean the skin.

#### c. Controls Diabetes

Scientists from the Indian Institute of Chemical Technology have found that eating unprocessed, horse gram seeds (raw, unsprouted) following a meal can reduce the glycemic index, by slowing down carbohydrate digestion and reducing insulin resistance.

#### d. Promotes Weight Loss

The seeds of horse gram have natural qualities that work as fat burners. It can

reduce the LDL cholesterol and increase the HDL cholesterol. Studies have proven that horse gram seeds can directly attack the fatty tissues stored in the body. It is favourable in melting body fat and gives a proper shape to the body.

#### e. Improves Sperm Count

The calcium, phosphorus, iron and amino acids in horse gram boost the sperm count. These minerals positively act on the male reproductive system, increasing blood flow to those organs, while the amino acids augment enzyme activity, which in turn assures optimal generation of sperms.

#### f. Protects Liver Functions

The raw seeds of horse gram are a powerhouse of potent plant substances, namely flavonoids and polyphenols. These compounds confer hepatoprotective properties towards the liver and gall bladder, safeguarding their key roles in filtering and purifying the blood and detoxifying chemicals in the body.

#### g. Treats Kidney Stones

Kidney stones occur due to crystallization of calcium phosphate salts in the body. Horse gram seeds, being infused with powerful antioxidants, play a central role in inhibiting this salt hardening process. Thus, it is very efficacious in eliminating harmful free radicals from causing injury to healthy kidney cells. Horse gram is also a dynamic ingredient in promptly remedying kidney disorders.

#### h. Treats Menstrual Disorders

Horse gram contains high levels of iron which helps to cure irregular menstrual cycles. By increasing haemoglobin levels owing to its high iron content, it reduces the chance of anaemia besides a thick, yellowish vaginal discharge also known as leucorrhoea from the body

#### i. Heals Ulcers

Due to the presence of phytosterol esters, horse gram has significant anti-ulcer activity. These naturally occurring compounds that are found in plant cell membranes are abundantly available in horse gram. They are highly beneficial in healing the mouth as well as peptic ulcers.

#### j. Fights Free Radicals

Loaded with polyphenols, flavonoids, and major antioxidants that help neutralize harmful free radicals in our bodies, horse gram has strong qualities to protect your cells against free radicals that could lead to life-threatening cancers and tumors.

#### k. Prevents Bone Diseases

Besides being high in iron and protein, horse gram has highest calcium content among all the pulses. It also contains significant traces of phosphorous and other amino acids which make it an ideal legume to prevent bone-related problems.

### SIDE EFFECTS, RISKS AND CONTRAINDICATIONS:

- Avoid the intake of horse gram and other pulses when suffering from gout, as uric acid levels are already alarmingly high around the joints in this condition and legumes could contribute to further increasing acidity.
- Consume horse gram seeds moderately during pregnancy, as it could tremendously increase body heat, when eaten in large amounts.
- Do not take horse gram-based food items in case you are also ingesting shilajit, an ayurvedic concoction.

### CONCLUSION

Horse gram is an important climate-smart grain legume, adaptable to extreme weather conditions and resilient to various biotic and abiotic stresses. It is indeed a superfood, owing to its immense nutritive values and fitness benefits. As long as caution is exercised in not consuming excessive quantities of this legume, it is highly recommended to include horse gram in your regular diet, to reap the excellent merits it provides, for complete healthcare. Special emphasis need to be given for introduction and popularization of pulses like horse gram for increase in area, production and productivity in biotic and abiotic stress prone areas in West Bengal for achieving self sufficiency in pulse production.

