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Chow-Chow (*Sechium edule*): Best Alternative to Shifting Cultivation in Mizoram

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ABSTRACT

Chow-chow (*Sechium edule*, iskut in Mizo dialect) is a boon crop of Mizoram and has potential for improving the socio-economic status of the tribal community. It is one of the most popular vegetables grown for its fruits, tender shoots, young leaves and the tuberized roots. Low calorific value of fruits makes it suitable for hospital diets/ baby foods and could also supplement to potatoes for diabetic patients. The vines climbs by clinging with tenacious tendrils, flowers are monoecious, fruits are mostly solitary, pear shaped, single seeded, viviparous with fairly bland taste of potato and cucumber. Mostly it is being cultivated on hilly terrain and the vines are trained over bower system, and even the hills having >100 % slope, where no cultivation is possible, is also under chow-chow cultivation. A flagship programme on commercialization of chow-chow cultivation in Mizoram will not only be an alternative to shifting cultivation; but also help in sustaining the farmers' livelihood, reducing the runoff and soil erosion, and conserving the natural resources.

1. Introduction

Chow-chow [*Sechium edule* (Jacq) Swartz]; also known as chayote and or squash in North-eastern regions of India or iskut in Mizo vernacular and a member of cucurbitaceous family; is most popular and high productive vegetable of Mizoram. It is known to have originated in the cool mountains of Central America where it was first domesticated by the Aztecs (Newstrom 1991). However, the credit for introducing chow-chow in the state of Mizoram and other parts of India is goes to the Western Missionaries. In Mizoram, the chow-chow is cultivated for its fruits, tender shoots, young leaves and the tuberized roots which are eaten as vegetable, mixed with meats or as an ingredient of soup and other preparations (Singh et al. 2012, Singh et al. 2013). Tuberous roots are used as like potatoes. Even the older leaves and damaged fruits are used as pig feed.

Thus, it is evident that none of the plant parts of chow-chow is wasted in Mizoram where the crop has an immense food and feed value. In order to start permanent farming, the farmers of Sihphir village (Aizawl district) initiated the cultivation of chow-chow in organized way for their livelihood in the year 1982. Simultaneously, the Govt. of Mizoram helped the farmers in the marketing of their produce by providing price support subsidy during 1990's. This helped the farmers in the commercialization and export of chow-chow fruits to the neighbouring North-east states, West Bengal and Bangladesh. This is the only vegetable in Mizoram which has an organized marketing system. A well-organized association known as 'Iskut Growers Association' is managing the marketing of chow-chow, especially its export to other states (Anonymous 2009a). Chow-chow requires medium to high altitude site (800-2000 m asl), moderate temperature (13-21°C), high relative humidity (80-85%), well-distributed annual rainfall (1500-2500 mm) and 12 hours of daylight to grow and fruit (Engles and Jaffrey 1993, Saade 1996).

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Mizoram, part of Lushai hills during British period, is located at 21°58' to 23°35'N latitude and 92°15' to 93°29'E longitude. The undulated topography of Mizoram has varied altitudes and annual rainfall ranging from 21-2157 m and 2000-3200 mm, respectively. In summer (Monsoon), mean monthly temperature ranges from 14.6 °C to 29.6 °C, while during winter minimum temperature falls up to 11.8 °C. The total geographical area is 2108700 ha, of which forest covers in 75.6 %, net sown area constitutes only 4.92 % (103835 ha), and shifting cultivation in 40089 ha area (Anonymous 2009b). Shifting (Jhum or Slash-and-burn) cultivation is a primitive practice of cultivation in the States of North Eastern Hill Region and tribal areas of India. The practice involves first clearing of vegetation/forest cover, drying, burning it before onset of monsoon, and growing crops on it. After harvest, this land is left fallow and vegetative regeneration is allowed on it till the land becomes reusable. Initially, Jhum cycle was long (15-25 years), but it reduced to 5-6 years due to ever increasing population pressure which ultimately poses the problem of land degradation and threat to ecology. Presently, Mizoram is producing 206314 t of vegetables including tuber crops and spices with a productivity of 16.9 t/ha. Nevertheless, the productivity of chow-chow is 37 t/ha.

Chow-chow cultivation in Mizoram

Geographically, Mizoram is one of the smallest states of India, but biggest producer of chow-chow. Its commercial cultivation is confined in Aizawl district of Mizoram, mainly the locality of Sihphir; which has cooler climate (8-32 °C), good annual rainfall (2500-3000 mm), hilly terrain, and situated at 23.49°N latitude, 92.44°E longitude and 1170 m altitude. The total area of chow-chow in Mizoram was 714 ha along with a productivity of 37 t/ha in 2008 which is increasing continuously i.e. 535 ha in 2002 (Anonymous 2009b). Sihphir, the most important chow-chow growing area, contributes to an extent of 72% area and 80% production (Figure 1 and Figure 2).

Nutritional value

Chow-chow is a good source of nutrients and vitamins (Table 1). The fruits and seeds have higher antioxidant activity (Ordonez et al. 2006) and are rich in several important amino acids (aspartic acid, glutamic acid, alanine, arginine, cystein, phenylalanine, glycine, histidine, isoleucine, leucine, methionine, proline, serine, tyrosine, threonine and valine). The softness of the fruit flesh makes it particularly suitable for giving consistency to baby foods, juices, sauces and pastes.

Many of these nutritional characteristics make it suitable for hospital diets. Low calorific value of chow-chow fruits could be a best alternative to supplement potatoes especially for diabetic patients. Because of the flexibility and strength of the vine stems, they are used as rope in handicrafts to make baskets and hats.

Table 1: Chemical composition (per 100 g) of chow-chow (Saade 1996, Aung et al. 1990, Verma et al. 2014)

Component	Fruit	Shoot and leaf	Tuberized root
Water (g)	94	90	80
Calorie (kcal)	28	60	79
Starch (g)	0.2	0.7	13.6
Protein (g)	1	4	2
Fat (g)	0.2	0.4	0.2
Carbohydrate (g)	5.6	4.7	17.8
Fibre (g)	0.7	1.2	0.4
Ashes (g)	0.5	1.2	1.0
Ca (mg)	15.5	58	7
P (mg)	17	108	34
Fe (mg)	0.4	2.5	0.8
Vitamin-A (mg)	5	615	-
Thiamin (mg)	0.03	0.08	0.05
Riboflavin (mg)	0.04	0.18	0.03
Niacin (mg)	0.5	1.1	0.9
Vitamin-C (mg)	15.5	16.0	19.0

Culture and growth physiology

Chow-chow is normally propagated by planting of 3-4 whole fruits in a hill, particularly the sprouted ones during January-February at 3-5 m apart. The average duration of the crop productive cycle is about 5-8 years. Their tuber is perennial in nature and re-grows in the every spring (February-March) after light freezes in winter which kills the vines. It is an herbaceous, vigorous climber, monoecious, viviparous and single-seeded cucurbitaceous plant. The angular-grooved vines, up to 10 m long, grow by clinging with tenacious tendrils and are trained on the bower system or on the trees. Its leaves are broadly triangulate and ovate-cordate to sub-orbicular in shape along with 10-15 cm long sulcate petioles and 3-5 divided tendrils. The flowers are unisexual, normally pentamerous, coaxillary and with nectaries at the base of the calyx. The staminate flowers grow in axillary racemose inflorescences (10-30 cm long) and the

There are also five stamens and the filaments are fused almost along their total length, forming a thickened column which separates at the apex into 3-5 short branches. The pistillate flowers are too on the same axilla as the staminate flowers; they are usually solitary but are occasionally in pairs. The fruit is solitary or rarely occurs in pairs, pear shaped, fleshy, and viviparous i.e. the seed germinates inside the fruit even when it is still on the vine. The flesh has a fairly bland taste, and a texture described as a mixture between a potato and cucumber. The fruits differ for shape, size, colour, surface smoothness and spine density (Rai et al. 2006)¹⁰.

In Mizoram the fruits are generally available in markets from July-December; while tender shoots and leaves from June-December. During the later period, only few vegetables are available in the markets. However, tuberized roots are generally dug out from the aged vineyard, 2nd year onwards, when the vines are completely dry (January-March). The palatable economic produces of the chow-chow plant (fruits, tender shoots and tubers) are widely available in the markets for almost 10 months of a year i.e. June-March; indicating its importance, significance and diffusion in the Mizos' cuisine.

Scientific advances to improve adaptability, productivity and economic viability of chow-chow

Technological interventions to expand the cultivation in non-traditional areas and increase the productivity are aimed at the selection and breeding of varieties that have wider adaptability and higher yield potential; suitable crop morphology; and need based adoption of agronomic practices for better resource management. Four heat tolerant genotypes (Local-4, Local-2, Local-1 and Local-3) were identified by ICAR-RC-NEH Region, Mizoram Centre, Kolasib, Mizoram to expand its commercial cultivation in warmer climate i.e. non-traditional areas (Anonymous 2012). With regard to planting, digging of bigger size of pits (90×60 cm) as against the presently followed practices for planting of chow-chow would facilitate proper root development and water holding. Additionally, the application of organic source of nutrients and slow release fertilizers in split doses have been recommended for improving the soil physical properties and plant nutrient uptake, and for avoiding nutrient leaching from run-off in sloppy land (Anonymous 2012). Pruning/ removal of old and dried leaves in old crop is imperative to improve sunlight penetration within the crop canopy and for fruit setting (Singh et al. 2013). Moreover, exogenous application (injection via a punched cavity in the fruit adjacent to the embryo) of 1 mM tetracyclacis and 1 mM prohexadione inhibited fruit sprouting (Aung et al. 2004).

group of flowers is distributed along the rachis having five sepals and five petals.

Promoting smooth surface cultivars (spineless) and inhibition of viviparous sprouting would facilitate better transportation and longer post-harvest shelf-life.

Limitations and opportunities of Mizoram region: Chow-chow cultivation holds potential

- Presently, a total of 40,089 ha area in Mizoram is under Jhum cultivation which is 38.61% of net sown area and 1.90% of total geographical area. On the other hand, its presence is almost zero in Sihphir because of intensive commercial cultivation of chow-chow. Even the hilly terrain having >100% slope, where no cultivation is possible, is also under chow-chow cultivation (Figure 1 and Figure 2).



Figure 1: Aerial view of chow-chow vine-yard



Figure 2: Inside view of chow-chow vine-yard

- Water stress is one of the major agricultural concerns of state. Mizoram receives an average annual rainfall of 2500 mm mainly from April-October and only 10-40 mm of rain during November-March. Both low (deficit) and high (excess) water availability is detrimental to crop productivity. But, the chow-chow plants are least affected by both type of water stress since it requires a good rainfall to favour plant growth during April-

- Soil erosion and degradation is a key worry in hilly region having high annual rainfall. Plants of chow-chow prefer medium–high altitude hills (800-2000 m asl) and high annual rain (1500-2500 mm) to grow well and produce more. Shifting cultivation, hilly terrain and high rainfall altogether aggravated runoff and soil erosion, and ultimately degrade soil quality; and thereby decreasing the crop productivity and deteriorating ecology. Since chow-chow is commercially cultivated on Bower System, hence the problems of soil and water erosion are least in under chow-chow vine-yard.
- Unavailability of wider adaptable genotypes is another major worry which limits its area expansion in non-traditional area (warmer region) of Mizoram. The systematic and continuous research strategies would certainly facilitate in developing the wider adaptable cultivars that are suitable to non-traditional areas.
- The crop needs initial investment of Rs. 1.10-1.30 lakh/ ha for making the GI wired bower system to train the vines overhead. Higher initial cost for erection of permanent bower system is also hindering its commercial cultivation because of fragile nature of tribal farming communities. Special financial assistance from the Government is necessary to promote its cultivation extensively.

Conclusion

In conclusion, it could be aptly said that promoting the commercialization of chow-chow cultivation in Mizoram will help in shifting towards permanent agriculture, sustaining the farmers' livelihood, increasing the productivity, reducing the runoff and soil erosion, and conserving the natural resources and ecology. Chow-chow is a boon crop for Mizoram and has potential for improving the socio-economic status of the tribal community.

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