



Genetic Variability in Indigenous Brinjal Land Races of Dimapur District of Nagaland and their Traditional Cultivation Practices

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Abstract

Generally significant genetic variability is observed in the available brinjal land races found in the low altitude growing areas in the state of Nagaland, India. They possess several unique characteristics of plant breeding importance with enough scope for further improvement to suit the traditional growing conditions of the state. Many of these land races also show good genetic resistance and/or tolerance to some biotic stresses. Therefore, the land races could also serve as good source of resistance or tolerance in plant breeding programs. This present study reports a large variability of land races in high land of Nagaland. There is enormous potentials of semi-perennial races and the immature fruits also possess certain medicinal properties as per the traditional belief. Systematic documentation and preservation of these valuable germplasm resources need immediate attention of scientific communities of the country. In the present investigation the genetic variability with respect to certain economic traits in a few traditional land races of brinjal in Dimapur district of Nagaland were studied

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1. Introduction

Plant breeding emphasises on the genetic improvement of crop plants to enhance their yield potential and also to develop other worthy plant qualities like desirable resistance against biotic and abiotic factors, improved plant ideotype, etc. In any country and for any crop, the rate of advancement of crop improvement works will mainly depend upon the amount of existing natural genetic variability for various crop economic characters. The genetic variability worth of a country may be considered as the greatest gift of the nature, which could be further utilised for human welfare.

Vegetables play an important role in daily human diet in terms of supply of essential minerals, vitamins and dietary fibers. As the end product of systematic plant breeding approaches, various improved and hybrid cultivars of different vegetable crops are now available in India. Among the solanaceous vegetables, brinjal/ egg plant/ aubergine is an important member which is believed to be originated in India. As a native crop of the country, it has been cultivated since time immemorial and at the same time a lot many traditional land races of brinjal (*Solanum melongena* L.) with distinct morphological characters are found in the sub-continent.

The north-eastern region of India is also famous for genetic diversity for many cultivated crops like rice, banana, citrus, chillies; pulses like black gram, green gram, rice bean and *arhar*; cucurbits; etc. including the egg plant. There are tremendous scopes of utilising the vast genetic worth of traditional land

races in plant breeding programs and thereby elite genotypes could be developed for commercial cultivations.

Brinjal (*Solanum melongena* L.) belongs to the family *Solanaceae* (Nightshade family) having the diploid chromosome number $2n=24$. Under *Solanaceae*, the genus *Solanum* is quite large with about 1500 described species (Dutta, 1996). In most of the intermediate altitude (within 350 m above msl) growing areas of Dimapur district of Nagaland, the farmers are preferably cultivating different land races of brinjal. According to Singh (1996), in any crop, land races refer to the primitive cultivars which were selected and cultivated traditionally by the farmers since time immemorial. These land races usually contain high level of genetic variability for economic characters like resistance to biotic and abiotic stresses and wider adaptability. In other words, land races have wide genetic base, which attributes to their wide adaptability. In any crop, as the land races contain desirable resistant alleles or alleles for some other desirable traits, these are to be documented and conserved properly for any further reference and use. The disadvantages associated with the land races are that they are low yielder and less uniform as compared to modern high yielding varieties and as a result of this, the land races are rapidly replaced by modern varieties for most of the field and horticultural crops. In contrast to this, in the state of Nagaland, modern high yielding varieties of solanaceous vegetables including brinjal are not popular, but at the same time the documentation, characterisation and conservation of these land races are important issues needing immediate



attention. On the other hand, the traditional cultivation practices of the land races also have some distinctness. In the present investigation an attempt was made to study the specific plant breeding worthy traits of a few collected brinjal land races of Nagaland along with the traditional practices associated with these land races.

2. Materials and Methods

In the present investigation, effort was made to document the genetic variability and the traditional cultivation practices of the popular brinjal land races of foot hills of Nagaland (within 350 m above msl). For the purpose, visits were made by the scientists of Department of Genetics and Plant Breeding, SASRD, Medziphema, Nagaland to the farmers' field in Dimapur district of Nagaland in September, 2007. During the visits, elderly farmers of above 40 years age were interviewed with the help of a pre-tested interview schedule to obtain the necessary information in relation to brinjal land races. On the other hand, based on the practical field experience and local information, ten distinct germplasms were collected from for further study in the greenhouse as well as experimental field conditions. In August and September of 2008, village market surveys were also done to record the genetic diversity particularly in terms of fruit shape, size and colour.

The collected traditional land races were grown and observed during September, 2008 to March, 2009 in the experimental field of Department of Genetics and Plant Breeding, SASRD, Nagaland (350 m above msl). A few morphological traits together with the incidence of insect pests and diseases were studied in these land races.

3. Results and Discussion

Brinjal is an annual plant, but usually traditional land races in Nagaland are kept in the kitchen gardens and *jhum* paddy fields for 2-3 years. In contrast to this practice, most high yielding varieties are cultivated on annual basis in the adjoining state like Assam. Another interesting fact revealed from the present investigation is that the high yielding cultivars are not popular in the state, especially in the intermediate altitude areas where brinjal is a common crop. The traditional sowing seasons of the crop in these areas are March/ April and August/ September. This was revealed in the field investigation that in the second and third year of cultivation, brinjals could be harvested almost round the year and the peak harvesting period is from May to September. The yielding ability of these land races was reported to be so high that at least half a kg fruits could be harvested from each plant in a week during the peak harvesting period starting from the second year of cultivation. In the traditional fields these genotypes are grown and cultivated without application of artificial nutrients and pesticidal chemicals. In some areas, pruning of old braches of the plants is also done in the month of February/ March in order to encourage new branching in the second and third year of cultivation. All these field observations actually indicate the genetic worth of the land races which are grown without much care and attentions in the traditional growing areas of the state.

Under the species *melongena* three botanical varieties are found (Chadha, 1993). Brinjals with round fruits are placed in

var. *esculentum*, slender and long fruited brinjals are under var. *serpentinum* and the dwarf brinjal types were identified to be under the var. *depressum*. In the present investigation also variability with respect to fruit shape was recorded (Table 2). Among the studied land races, the maximum average fruit length for purple long land race was recorded to be 17.27 cm with the minimum average fruit circumference of 2.23 cm. On the other hand, maximum average fruit circumference of 11.15 cm together with minimum fruit length of 6.12 cm was recorded for white egg type brinjal land race.

On the other hand, to utilise the traditional land races in hybridization programmes, the flower morphology with respect to style characteristics is of much importance. Heterostyle phenomenon and its effect in fruit set and fruit formation processes were reported by several researchers (Fonseka et al., 2002 and Chadha, 1993). According to these studies at least three types of flowers may be found in brinjal on the basis of heterostyle and ovary characteristics:

- Long styled flower with stigma protruding out of anther column / cone
- Short styled/medium short styled/ pseudo short styled flower with stigma inside the anther column
- True short styled flower with rudimentary female organs (Pal and Singh, 1943)

Baksh and Iqbal (1979) reported that even within the same plant these different types of flowers may be found and the character may be attributed to varietal (genetical) factors and also the seasonal factors. The contribution of long styled flowers towards fruit formation was recorded to be much greater as compared to other short styled flowers in the investigation of Fonseka et al., 2002. They also reported that true short styled flowers with rudimentary ovary act as male flower only. On the other hand, in the investigation of Vivekanandan and Subramanian, 1991; high genotypic coefficient of variation was reported for style length of egg plant which also indicates the role of genetic factors for this trait.

The heterostyle phenomenon to varying degree was also recorded in the land races studied in the present investigation. However the percentage of long styled flowers was always observed to be always greater than 50% in the studied brinjal land races. On the other hand, the flower in different studied land races in the day of anthesis was observed to be dark and light purple in colour.

Modern high yielding varieties of egg plants which are usually cultivated in annual basis grow up to a height of 60-120 cm. In the present survey 2-3 years old egg plants with the height range of 2-2.5 m were noticed in traditional growing areas at the foot hills of Dimapur district of Nagaland. In the experimental field of department of Genetics and Plant Breeding, SASRD, Medziphema the maximum average plant height was observed to be 82.09 cm at the age of six months for the land race bearing white fruits with purplish tinge and the minimum average height of 65.82 cm at the age of six months was noticed for the white egg fruit type land race. These land races are well branched, spreading with well built frames against the erect and compact characteristics of modern varieties. The genetics of spreading plant habit and erect ness was studied by Vijayagopal and Sethumadhava, 1973 and they found that erectness is dominant over spreading trait. In the present investigation, the spreading



habit was more pronounced in the white egg type fruited land race as compared to the others. On the other hand, the land races with a height up to 2.5 metres noticed during the field survey were supported by strong well lignified root systems. In some genotypes the presence well developed spines in the stem is well observable.

The leaves are large, lobed and simple and alternate and in some land races small but well built spines are observed to develop along costa and lateral veins. Sparse to dense spines were also observed in the branches of these studied land races. On the other hand, the collected land races showed genetic variation in flower colour which ranged from white to deep purple. In brinjal purple flower colour is dominant over white or light purple colour (Khapre et al., 1986). The flowers are comparatively large and it could be safely stated that emasculation and pollination processes are easy as compared to other solanaceous vegetables like chillies, tomatoes etc. In some traditional land races the calyx also develops small spines during the process of fruit development.

The most easily noticeable variations in the collected land races of the present study were in respect of fruit size and fruit colouration. It was reported that purple fruit colouration is dominant over green colour and green fruit colour is dominant over white fruit colour (Khan and Ramzan, 1954). On the other hand elongated fruit shape dominant over round fruit type (Choudhury, 1977). The range of fruit weight recorded in the studied land races varied from 10.27 to 24.51 g and usually long purple and long green land races produced heavier fruits as compared to the white and white with purplish tinge type of fruits. The fruit of most of the studied brinjal land races contained good amount of seeds fruit⁻¹, the range recorded being 292 to 433. The white egg and white with purplish tinge type of fruits were observed to be more seedy as compared to other studied land races.

The farmers of different traditional growing pockets informed that there are differences in taste of immature fruits of brinjal depending upon their shape and colour. During local village market visits in the district of Dimapur, Nagaland the local preference was observed to be high for round white, medium long white and long purple type of fruits. On the other hand, all the land races bear only small sized fruits with small number of seeds as compared to modern high yielding varieties.

The infestation of brinjal fruit and shoot borer (*Leucinodes orbonalis*) was recorded to a very limited in the collected land races and the same fact was also informed by traditional farmers during the field visits in Dimapur district of Nagaland. It is worth mentioning here that the spiny white round fruited genotypes are very hardy in nature and they remains virtually free from the infestation of fruit and shoot borer. This indicates the possibility of utilising this particular genotype for developing genetically resistant modern varieties against the pest.

The range and classes of a few morphological traits these brinjal land races are presented in table 1 and 2.

4. Conclusion

Based on the preliminary observations in these land races, following plant breeding aims may be fixed with reference to these land races of brinjal:

1. Large scale screening and evaluation of available land races for yielding ability and resistance to biotic and abiotic stresses should be carried out in order to select a few potential land races for cultivation under the traditional growing situations of Nagaland.
2. Improvement in fruit size could be achieved with the aid of inter varietal crosses followed by careful selections.
3. Hardiness and resistance/ tolerance genes against biotic factors of the land races could be transferred and utilised in otherwise good high yielding cultivars of brinjal.

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Table 1: Range and classes of a few morphological traits in ten local land races of brinjal of Nagaland

Plant height at 6 months age (cm)	Growth habit	Thorniness in leaf, branch and calyx	Flower colour (day of anthesis)	Fruits plant ⁻¹ (up to 6 months age)	100 seeds weight (mg)
65.82-82.09	Mostly spreading type, well branched	Sparse to dense thorns	Light purple and dark purple	27.82 – 62.08	320.23-412.57

Table 2: Range and classes of a few fruit characteristics in ten local land races of brinjal of Nagaland

Fruit shape	Fruit colour at immature stage	Fruit colour at full maturity	Fruit length (cm)	Fruit maximum circumference (cm)	Fruit weight (g)	Seeds fruit ⁻¹
Round, oval, long	White, white with purple tinge, green, dark purple	Dark yellow, dark yellow with brown stripes, yellow	6.12-17.27	2.23-11.15	10.27-24.51	292-433



Figure 1: Brinjal with rudimentary stigma



Figure 2: Long green brinjal



Figure 3: White egg type brinjal



Figure 4: Variation in fruit size and shape



Figure 5: Brinjal land races are usually thorny



Figure 6: White egg brinjal become yellow at maturity



Figure 7: Purple long brinjal



Figure 8: Spreading habit



Figure 9: Fruit flower with long protruding stigma