Ricebean: a multipurpose underutilised legume

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Summary

Ricebean (*Vigna umbellata*) is a neglected legume regarded as a minor food and fodder crop in Nepal and northern India, and grown in a range of cropping systems with maize during summer, as a sole crop in the uplands, on rice bunds or in home gardens. It is mainly grown for human consumption, though it is also used for fodder and green manure. There has been very little research or development support for this crop and farmers mainly grow landraces. There is no published literature on ricebean regarding its area coverage, production, productivity, utilisation and marketing. It is grown by subsistence farmers in a very limited scale and most of the produce is consumed at home, although there is a limited market for a short period each year. The crop contributes to household food security; several food items are prepared from ricebean, it is culturally important and is thought to have important nutritional values. Ricebean foliage and dry straw are valuable livestock feed, and when used as a green manure it improves soil fertility. This paper describes diversity in ricebean germplasm, indigenous knowledge in Nepal on ricebean, farmers' preferences and future prospects for the crop.

Introduction

Like other Vigna species, ricebean (*Vigna umbellata*) is a warm-season annual. Grown mainly as a dried pulse, it is also important as a fodder and as a green manure. The dried seeds are highly nutritious and as the protein is high in lysine they make an excellent addition to a cereal-based diet. The seeds are also high in mineral content, and in vitamins, including thiamine, riboflavin, niacin and ascorbic acid.

The presumed centre of domestication is Indo-China – it is thought to be derived from the wild form *V. umbellata* var *gracilis*, with which it is cross-fertile, and which is distributed from Southern China through the north of Vietnam, Laos and Thailand into Burma and India (Lawn, 1995; Tomooka *et al*., 1991). Wild forms are typically fine-stemmed, freely-branching and small-leaved, with a twining habit, photoperiod sensitivity and indeterminate growth (Lawn, 1995). Flowering is asynchronous, and there is a tendency to hard seeds. In many areas, landraces which retain many of these characteristics persist, in particular with regard to daylight sensitivity, growth habit and hard seeds.

Ricebean is a neglected crop, cultivated on small areas by subsistence farmers in hill areas of Nepal, northern India and parts of SE Asia. It can be grown in diverse conditions and is well known among farmers for its wide adaptation and production even in marginal lands, drought-prone sloping areas, and flat rainfed *tars* (unirrigated, ancient alluvial river fans). It is mainly grown between 700 and 1300 m a.s.l., although in home gardens it is found from 200 up to 2000 m. There is almost no published literature on ricebean in Nepal, even grey literature with relevant information on its area and distribution and the potential of the crop is lacking. Most

of the crop currently grown in Nepal is used for human nutrition, with a smaller proportion used for fodder and green manuring. Generally, ricebean is grown as an intercrop with maize, on rice bunds or on the terrace risers, as a sole crop on the uplands or as a mixed crop with maize in the *khet* (bunded parcels of lands where transplanted rice is grown) land. Under mixed cropping with maize it is usually broadcast some time between sowing maize and that crop's first and second earthing up, so ricebean sowing extends from April-May to June.

The crop receives almost no inputs, and is grown on residual fertility and moisture and in marginal and exhausted soils. Anecdotal evidences indicate that the area and production of ricebean in Nepal is declining due to the introduction of high yielding maize varieties and increasing use of chemical fertilizers, while consumption is decreasing due to increased availability of more preferred pulses in the local markets. No modern plant breeding has been done and only landraces which have low yield potential are grown. These have to compete with other summer legumes such as soybeans (*Glycine max*), black gram (*Vigna mungo*), cowpea (*V. unguiculata*), common beans (*Phaseolus vulgaris*) and horse gram (*Mactotyloma uniflorum*). Other production constraints that limit the production of ricebean include small and fragmented land holdings and declining productivity.

So far little has been done to exploit the potential of ricebean. It is well adapted to the humid tropics and does well on many soil types, but has several features that need attention before it could be widely adopted. Most varieties are highly photoperiod sensitive, and when grown in the Nepal are late flowering and have strong vegetative growth. Their twining habit makes them very suitable for use as intercrops with such species as maize, sorghum and millet, which can provide support, but also makes them difficult to harvest. Many current varieties are susceptible to shattering, and show high levels of hard seededness.

There is no institutional support either from research or from the extension services for the development and promotion of this crop. Despite this, as a legume ricebean should have an important contribution to make to mixed subsistence farming systems, it is important culturally, and is thought to possess important nutritional characteristics which could give it a major role in improved diets and food security in the areas where it is currently grown and elsewhere. This paper describes the initial work of a major initiative under the INCO programme of the European Commission's Sixth Framework Programme (FP6), FOSRIN (Food Security through Ricebean Research in India and Nepal), which aims to popularise ricebean on a wider scale, assess economic (production chain) and nutritional aspects of the crop, and evaluate the range of germplasm and indigenous knowledge available.

Methods and materials

Germplasm evaluation

Ricebean germplasm was collected by the Plant Genetic Resources unit of the Nepal Agriculture Research Council (NARC) from 25 districts of the country in various missions between 1972 and 1994. In April-May 2006, germplasm was also collected from 16 districts of Nepal (eight of those districts previously not covered) by

mobilising two non-government organisations, the SUPPORT Foundation (8 districts) and the Rapti Agriculture Graduates Society (RAS)-Nepal (3 districts). Local Initiatives for Biodiversity, Research and Development (LI-BIRD) (3 districts), CAZS-Natural Resources (CAZS-NR) and NARC (2 districts) also collected germplasm. In total 273 ricebean accessions collected from over 30 districts in Nepal were evaluated at 2 sites in summer 2006 (Table 1, Figures 1). The process was coordinated by LI-BIRD.

Table 1. Districts and organizations involved in ricebean landraces in collection in Nepal, 1972 – 1994 and 2006

Name of district	No. of accessions	Collected by
Arghakhanchi, Baitadi, Bajura, Bajhang, Bhaktapur, Bhojpur, Dang, Dhankuta, Gorkha, Gulmi, Humla, Ilam, Jhapa, Kabhre, Kalikot, Khotang, Lalitpur, Lamjung, Mugu, Myagdi, Nuwakot, Okhaldungha, Pyuthan, Tanahun, Terhathum	117	NARC (historical)
Achham, Bajura, Baitadi, Bajhang, Dadeldhura, Doti, Darchula, Surkhet,	71	SUPPORT Foundation
Gulmi, Kaski, Palpa	48	LI-BIRD
Kabhre, Nuwakot	17	CAZS-NR/NARC
Dang, Pyuthan, Salyan	20	RAS-Nepal
Total	273	

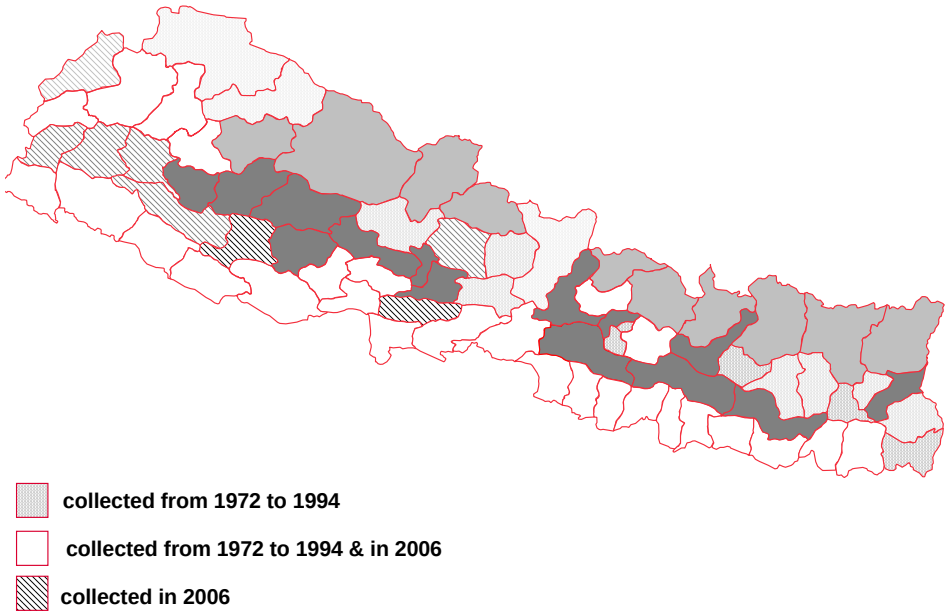

Figure 1. Ricebean germplasm collection in Nepal from 1972 to 1994 and in 2006. High hill and mountain districts are shown in light grey, mid hills in dark grey and terai in white.

Initial germplasm evaluation in 2006 was carried out at two sites; the NARC Research Farm at Khumaltar, Lalitpur (1350 m), and with farmers of the Darbar Devisthan Village Development Committee (VDC – the smallest political unit in Nepal) in Gulmi district (1500 m) in the Middle Hills (Figure 2).

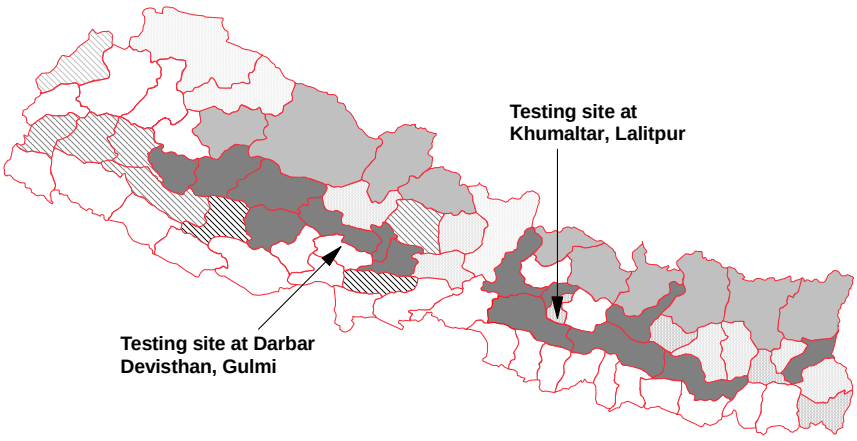

Figure 2. Ricebean germplasm evaluation sites in Nepal, 2006. High hill and mountain districts are shown in light grey, mid hills in dark grey and terai in white.

Germplasm evaluation on-station: The germplasm evaluated at Khumaltar included the historical collections (117 accessions) collected from 1972 to 1994. These were evaluated in raised single row plots of 2 m length with a spacing of 25 cm between plants. Three seeds were planted per hill and subsequently two seedlings were thinned out after the crop was fully established. The plots were managed in the same way as farmers' customary practices, and neither fertilizer nor irrigation were applied. Various agro-morphological traits were recorded at different crop growth stages (Table 2) following the "Descriptors for grain legumes and oil seed crops" (Anonymous, 1995).

Germplasm evaluation on-farm: 156 germplasm accessions collected in 2006 from various parts of Nepal were planted for on-farm evaluation on 15-16 June 2006 at Darbar-Devisthan VDC in Gulmi district. Gulmi was selected for this as it represents a typical ricebean domain in the middle hills of Nepal, with predominantly sloping *bari* land (upland with big terrace risers) and low average rainfall. Another important feature of Gulmi is that traditionally farmers grow a range of legume species including ricebean in their *bari* lands, and so are very experienced in terms of indigenous knowledge related to the cultivation and utilisation of this crop. Ricebean currently occupies over 100 ha in Gulmi district (personal communication, District Agriculture Development Officer). As a result, using Gulmi would provide additional knowledge on the practices adopted by farmers for the cultivation of a range of legumes including ricebean.

The on-farm evaluation was managed by LI-BIRD. The trial was grown as a sole crop in a non-replicated observation nursery with two rows each of 4 m length (16 plants per plot). The crop was grown following farmers' customary agronomic practices, ploughing the land twice after applying farm yard manure (FYM) at a rate of 7.5 t/ha. No chemical fertilizers were used in the trial. Three seeds per hill were sown on raised beds with a spacing of 1 m between rows and 50 cm between plants. A single plant was retained after full establishment. Three weedings were done, the first 48 days after seeding (DAS), the second at 75 DAS and the third at 104 DAS (at flowering). Since most accessions were of indeterminate growth habit staking with bamboo sticks

was provided at 72 DAS for all plants showing an indeterminate growth habit. A range of agro-morphological parameters were evaluated (Table 2).

Table 2. Agro-morphological parameters studied during germplasm evaluation

Germplasm evaluation	Parameters covered
On farm	Dates of planting, flowering and maturity; growth habit, plant height at maturity, flower colour, pod length, number of pods per plant, number of seeds per pod, 100 seed weight, seed colour, total grain yield per plant
On Station	Dates of planting, flowering and maturity; growth habit, yield and yield components; number of pods per plant, 100 grain weight and grain yield per plant, disease and pest reactions

Some of the germplasm collected in 2006 did not germinate due to poor seed quality or hard seededness, while several others had poor growth, and some accessions were morphologically very similar to cowpea and black gram. As a result, data were collected and analyzed from only 74 of the accessions. Because of the indeterminate growth habit, time to maturity varied greatly between accessions, and harvesting ranged from September to November. As the first year study was carried out in order to developing a suitable protocol for more detailed work in the second year, the observations were recorded only from single plants and so could not be statistically analysed.

Indigenous knowledge and relative importance of ricebean

Farmers compared ricebean with most commonly grown legumes in the area, listed by the farmers as cowpea (locally called *swosta)*, pea (*Pisum sativum*), winter bean, *Gahate simi (Phaseolus lunatus),* lentil (*Lens culinaris*) and ricebean. A comparison was made considering taste, perceived nutritional value, and various usages.

Farmers' preferred trait analysis (PTA) and preference ranking for ricebean

Ricebean is commonly known as *Jhilinge* in the area. A preferred trait analysis (PTA) was carried out with farmers of the Darbar Devisthan VDC. A total of 325 farmers including women participated in a Focus Group Discussion (FGD) arranged for this purpose, although only 21 were found to be currently growing ricebean. An additional FGD was carried out in Ilam district. The FGDs collected farmers' perceptions on cultivation, cropping patterns, seed availability, uses, specific characters, and identified various constraints associated with ricebean cultivation and marketing. A preference ranking for the most commonly grown ricebean landraces was also done. Market price was not included in the analysis as most of the produce was consumed locally.

Results

Germplasm evaluation on-station

Ricebean varietal diversity: Variation for flowering and maturity between the accessions was quite high, and ranged from 61-104 days for flowering and 99-134

days for maturity. The high standard deviation indicated that accessions varied greatly for these traits, although the coefficient of variation for some of the quantitative traits was not high (7-8%) (Table 3). NPGR-05565, NPGR-06657 and NPGR-08380 were particularly early maturing. Yield and yield components showed very high variation, with some accessions very high yielding, for example NPGR-00195 (1300 g/m^2) and NPGR-05432 (1200 g/m^2). These results indicate that there is a great potential for making genetic advance through breeding or even through germplasm enhancement as these traits vary quite high.

Some of the accessions were infected with diseases and insect pests at flower initiation and pod formation. Rust, *Cercospora* leaf spot and web blight (*Rizoctonia* sps) were the major diseases recorded. These were scored, based upon damage. Web blight greatly affected the plants, with drying of foliage in NPGR-05382, NPGR-05432, NPGR-06591, NPGR-06657, NPGR-08380. The incidence of aphid infestations was also recorded. Most accessions from Illam, Bhojpur and Dhankuta were more resistant to rust, blight and *Cercospora* spots.

Table 3. Descriptive analysis of quantitative traits in ricebean landraces, Khumaltar, Nepal, 2006

Quantitative traits	**Mean**	**Range**	**Standard deviation**	**Coefficient of variation**
Leaflet length (cm)	11.7	7.0-14.3	0.89	0.08
Leaflet width (cm)	8.3	4.5-10.4	0.66	0.08
Days to flowering	87.1	61-104	9.02	0.10
Days to first mature pod	121.6	99-134	8.25	0.07
Pod length (cm)	7.7	5.3-11.6	1.38	0.19
Number of seeds per pod	6.7	5-9	0.88	0.13
100 seed weight (g)	6.8	5.2-8.9	0.77	0.11
Yield g-^{m2}	939.7	500-1300	150.87	0.15
Seed length (mm)	6.1	4.26-7.8	0.80	0.14
Seed width (mm)	3.3	2.54-3.98	0.33	0.10
Seed thickness (mm)	4.1	3.1-4.76	0.31	0.07

Promising accessions from the medium and late categories were selected for further analysis during the coming season, and for entry into mother-baby trials.

An analysis of the qualitative and quantitative data together was performed to show the genetic relationships between the accessions and their agro-ecological differentiation. High diversity was found between the accessions for most qualitative and quantitative traits, and two distinct groups were identified (Figure 3). The observed traits explained 38.4% of the total variation and showed a geographical cluster of genotypes in the western part of Nepal from the mid to the high-hills. Qualitative traits such as growth pattern, flowering behaviour and maturity were important for this clustering (Figure 3).

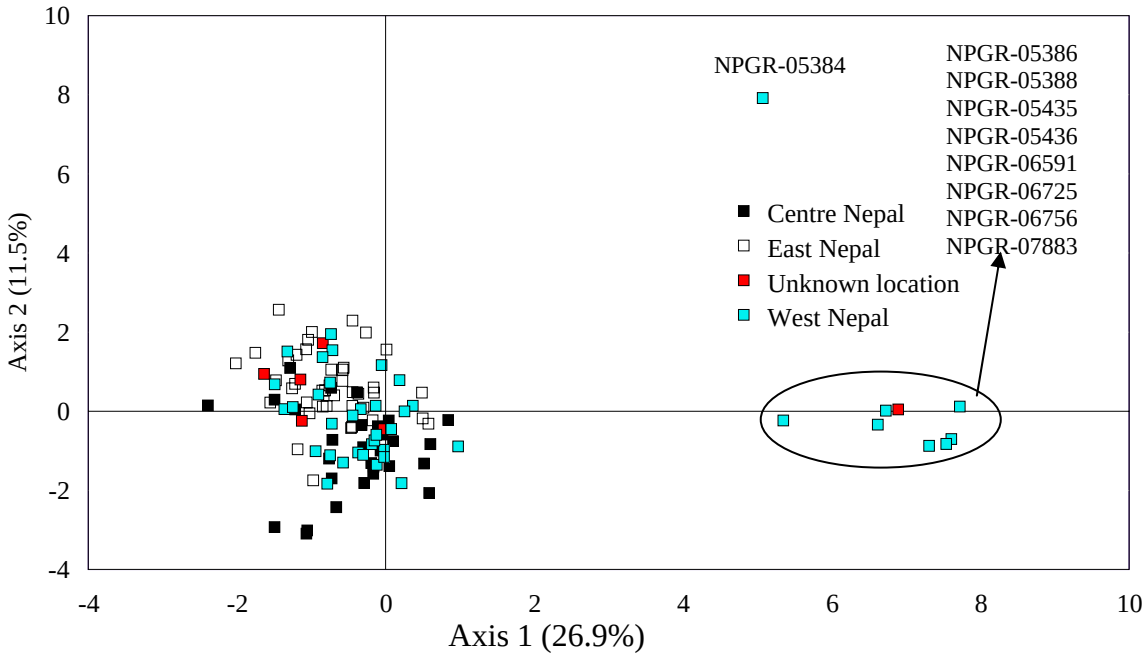

Figure 3. Scatter plot of ricebean landraces of Nepal collected from 1972 to 1994

Accessions NPGR-05384, NPGR-05386, NPGR-05388, NPGR-05435, NPGR-05436, NPGR-6591, NPGR-06725, NPGR-06756 and NPGR-07883 from high altitude sites (Humla, Mugu and Bajura) and a mid-hill site (Baitadi) were distinct and showed geographical differentiation. The important traits for this were growth pattern, twining tendency, days to 50% flowering and days to first pod maturity. All these accessions were determinate, with non-twining tendency but varied in flowering and first pod maturity, which ranged from 61-102 days for flowering and 99-134 days for maturity. Most accessions from Humla were early maturing, although a determinate accession from Mugu (NPGR-05384) was as late as the indeterminate types. Phenotypic diversity was higher for leaf pubescence (Shannon-Weaver index H = 0.67), flowering period (0.78), pod pubescence (0.77), number of seeds per pod (1.15), seed shape (0.55) and seed colour (0.50) with the overall index H' = 0.525.

In this diversity study the growth habit, duration of flowering, seed colour and size were the most important traits and showed high phenotypic diversity. Variation was observed between ricebean accessions for flowering and maturity period and for yield potential. These findings indicate great potential for improving ricebean through breeding. However, they are still preliminary and need further study before they can be confirmed.

On-farm evaluation

Ricebean accessions were evaluated in the field for phenology, yield and yield components and insect and disease reactions during the 2006 cropping season. Based upon days to maturity, 74 accessions were grouped into three major categories. The majority (48) were of medium maturity, and matured between 120 and 140 days from the time of seeding (Table 4). Only four accessions were early, while 22 took over 140 days to mature after planting.

Table 4. Category of accessions on the basis of maturity period in 2006

Maturity group	Maturity days after seeding	Number of accessions
Early	<120 days	4
Medium	120-140 days	48
Late	>140 days	22

The difference in flowering time between the early and medium groups was much wider than between the medium and late maturing groups. It is interesting that although the early maturing groups were tallest and had the most pods and seeds per pod they still gave the lowest yields. This was because all the early accessions matured during the peak rainy season, when grain filling was very poor, evident from the low seed weight of these accessions. The seeds of the late group were twice as large than the early ones, while the grains of the medium group were almost 43% larger than those of the early group (Table 5).

Table 5. Descriptive analysis of quantitative traits of early, medium and late maturing ricebean landraces, Darbar Devisthan, Gulmi, Nepal, 2006

Quantitative traits	Early		Medium		Late	
	Range	Mean	Range	Mean	Range	Mean
Days to flowering	55-79	76	75-112	91.8	95-112	98.9
Days to first mature pod	118	118	132-139	136.3	143-151	148.1
Plant height (cm)	190-212	199	119-273	186.7	129-268	195.3
Pod length (cm)	7-8.6	7.73	5.9-11.6	8.6	7-10.8	8.2
Number of pods per plant	121-353	268	58-516	241.1	35-285	158
Number of seeds per pod	7.2-8.1	7.7	2.4-9.5	6.9	4-7.2	5.9
100 seed weight (g)	4.3-7	6.1	5.3-14.3	8.7	6.6-23.4	12.2
Yield per plant (g)	47.7-161.3	86.9	26.1-274.4	103.2	27.1-170	81.1

This is important, as grain size is one of the most important parameters in terms of market price. Early maturing varieties could have a problem of small grain size, and in addition as they these will be harvested during the monsoon grain quality is likely to be poor due to low sun shine and high moisture during ripening and drying.

Out of seventy four accessions evaluated in 2006, 14 accessions from the medium group and 8 from the late group performed well for a number of economically important traits, for example number of pods per plant, grain yield and 100 seed weight. The germplasm also showed great diversity in seed colour.

A principal components analysis was carried out for the accessions collected in 2006 based on time to flowering and maturity, plant height, pod length, number of pods per plant, number of seeds per pod, 100 seed weight and total seed yield per plant. These traits showed the discrete diversity between the ricebean landraces. Unlike the historical accessions, there was no distinct clustering for the germplasm collected in 2006, although the accessions were also quite diverse for the traits analysed (Figure 4).

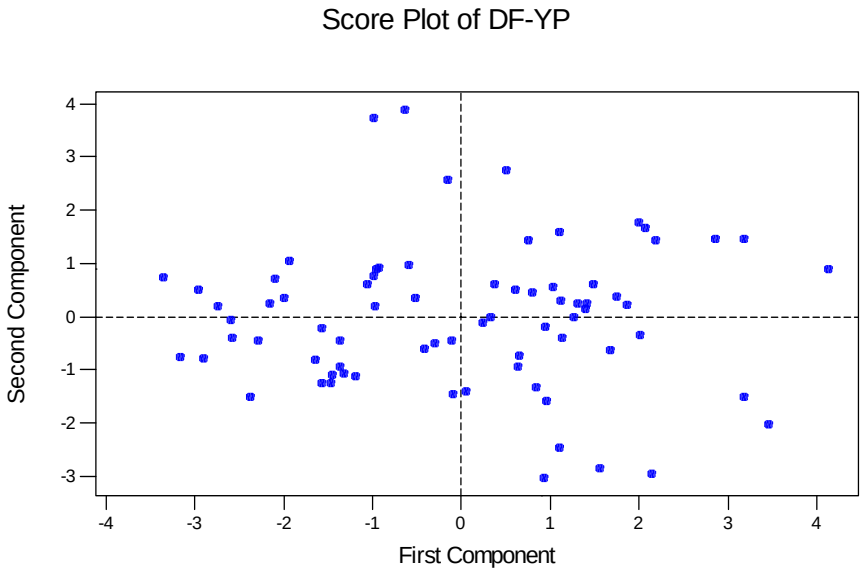

Figure 4. Scatter plot of ricebean landraces of Nepal collected in 2006

Farmer description of ricebean germplasm: Preliminary findings from FGDs in Gulmi and Ilam revealed that at least five types of ricebean are widely known. The farmers' descriptors mainly revolve round the colour and size of the grain (Table 6). *Kalo* (black) *masyang* is the most prevalent as it gives the highest yield and is also good for making *dal* (soup). *Rato* (red) *masynag* and *Thulo masyang* (large ricebean) are less common. The quality of the beans of *Rato Masyang* is not considered good, but although *Thulo masyang* is also less common it makes good *dal* and fetches a good price. It is a climber and can reach a height of 5-6 m if grown on poles or on trees. It may yield 2-4 kg of seed per plant. The seeds are yellowish or white and nearly round and have about the same shape as cowpeas. It appears to grow at a slightly higher altitude than the other varieties.

Pahenlo masyang (yellow ricebean), found in both determinate and indeterminate forms, is grown on *khet* terraces. The indeterminate trailing type is most commonly intercropped with maize.

Ghore or Khairo (brown) has large speckled beans and can be seen growing on stakes. The plant can be quite large and probably yields more fodder than grain, but the taste is not so good and marketing is difficult as a result.

In general ricebean *dal* is not preferred over that made from other pulses due to its strong taste and pungency. Of the ricebean *dals*, *Kalo* is the most preferred, followed by *Khairo* or *Ghore* while *Pahenlo Masyang* is considered to be the worst for *dal* due to its pungency. Unlike other legumes, the green pods of ricebean are not eaten as they are not tasty or smooth.

Table 6. Farmers' descriptors of major ricebean types in Durbar Devisthan, Gulmi and Ilam, Nepal 2006

Local name	English translation	Farmers' distinguishing traits
Gulmi		
Rato Jhilinge	Red ricebean	Red, small to medium sized grain, medium in maturity, drought tolerant, low yield
Khairo Thulo Jhilinge	Brown and bold grain	Brown with stripes and bold grains, late in maturity, high yielding
Seto Thulo Jhilinge or	White bold grain	Bold white to yellowish grains, late in
Pahenlo Thulo Jhilinge	Yellow bold grain	maturity, high yields
Bhadaure Jhilinge	Early small seeded	Greenish to yellowish, small grains, early maturity, low yields
Ilam		
Rato masyang	Red ricebean	It is less common
Ghore masyang	Brown ricebean	Large, brown or speckled beans, grows on stakes and plant can be quite large. High fodder yields
Pahenlo masyang	Yellow ricebean	Short determinate form grown on *khet* terraces , indeterminate larger one intercropped with maize
Thulo masyang	Large ricebean	Climbs strongly and can reach 5-6 meters if grown on poles or in trees, seeds are yellowish with some variegations

According to the farmers, no ricebean landraces have yet been lost from the village although the area, production, productivity and consumption of ricebean is said to be declining each year. In some parts of Nepal, ricebean is only grown on the edges of fields or on terrace risers including one row within the maize field. If grown in the main field, the trailing vines can cause maize to lodge, so reducing the maize yield. In some areas, ricebean is increasingly mixed with sorghum, which supports it better than maize.

Indigenous knowledge of ricebean on food and cultural values

Ricebean is known by several vernacular names, e.g. *Masyang, Jhilinge, Siltung*, and *Guruns*. It has multiple usages, and most parts of the crop are used for different purposes. For example the grains are used for making various kinds of food items (Table 7), in particular *dal*, *Biraula, Batuk* and *Masaura*. *Biraula* is a snack made of soaked ricebean either fried or steamed. *Batuk* is a deep fried cake made from the paste of black gram or ricebean or other legumes, made by crushing soaked grains of the legumes. *Masaura* is a kind of nugget made from the legume paste mixed with the chopped stalk of taro, preserved over several months and eaten in the form of curry with potato and other vegetables. Ricebean is also consumed as a snack, for example with roasted maize, and is eaten with local alcoholic drinks. It also has cultural importance, being used in local feasts or social gatherings as curry and in the form of snacks.

Table 7. Common uses of ricebean in Nepal with their importance

Plant part	Order of importance	Common uses	Preferred traits	Preferred landraces
Grain	1	*Dal*, curry, *Biraula*, *Batuk, Masaura*, *Khichadi (*rice and a legume cooked together: the proportion of rice is always more than of the legume), green pods for vegetable; snacks of various kind	Bold grains, higher yield, medium maturity, non-shattering determinate to semi determinate type, tasty, tolerant to high intensity of rainfall during early flowering stage	White large, brown large in terms of yield and grain size, taste but lack on other traits
Green foliage	2	Livestock fodder	Indeterminate type with luxurious vine growth, late maturity	Any late maturing, indeterminate landraces
Green foliage	3	Green manure	Indeterminate type with luxurious vine growth	Any late maturing, indeterminate landraces
Dry straw	4	Livestock feed		

There are some contradictions in farmers' opinions regarding the best season for eating ricebean. It is perceived to be a *cold* food, unsuitable for consumption during winter, particularly for children and old people, although in many parts of the country it is consumed during winter as well. However, framers from central Nepal confirmed that ricebean is mostly consumed between February and June (hot/warm season). People can consume it up to August provided when they think it is reasonably hot or warm. It is definitely considered as a cold food and not consumed during winter or on a cold day or even on a rainy day during summer. In the same area the transaction of ricebean (sale or exchange) is also closely linked with consumption pattern, which occurs between December to May. It will be really difficult to find ricebean in the villages after the planting season, you may be lucky if you did find in the market!

Ricebean is also known to cause flatulence and is believed to cause gastritis, although the reasons behind this are unknown. Some of these issues need further validation through more detailed studies and nutritional analysis of the crop. Farmers also emphasized the need for research on the chemical composition and nutritional value of ricebean in order to develop it and promote its wider cultivation and use.

Farmers also have an opinion on the value of different ricebean landraces for different purposes. For example *Seto Thulo* (white large) and *Khairo Thulo* (brown large) are considered the best for food, while landraces with a luxurious vegetative growth with indeterminate vines that mature late and yield high biomass are preferred for fodder. Both *Seto Thulo* and *Khairo Thulo* were identified as suitable for fodder purpose (Table 7). Fodder yields are important in Nepal, where livestock play a major role in the farming system. For green manuring and soil improvement, farmers preferred landraces with many broad leaves and more vines and medium to late maturity, although they did not mention any specific landrace by name.

Preference ranking of ricebean against most commonly grown legumes in the area

The most commonly grown legumes in the areas where ricebean is grown are cowpea (*swosta),* pea, winter bean, *Gahate simi (Phaseolus lunatus),* lentil and ricebean. Farmers ranked cowpea as the best, followed by pea in terms of taste, nutrition and common use value. Ricebean and *Gahate simi* (P. *lunatus*) were both ranked as the third most important legumes (Table 8). Lentil, another most common legumes, was not ranked in the top three.

Table 8. Farmers' preference ranking for common grain legumes at Darbar Devisthan, Gulmi, Nepal, 2006

Commonly grown legumes	**Taste**[†]	**Nutrition**	**Used as *dal*[§]**	**Total**	**Farmers' overall preference ranking**
Rice bean	3	4	3	10	3
Cowpea	1	2	1	4	1
Gahate simi	4	3	3	10	3
Pea	2	2	2	6	2
Winter bean	6	3	5	14	5
Lentil	5	5	4	14	5

[†] Rankings are based on the scores where lowest score is best and highest is worst, [§]*dal*/soup is most common use value of legumes in the area

Preferred trait analysis and preference ranking of ricebean in Darbar Devisthan

From the discussion it was found that around 80% farmers in the area grow ricebean, either on a small scale either fodder or green manure, or on a slightly larger area for grain and fodder as an intercrop with maize. The average land under ricebean was below one *ropani* (500 m^2) per household.

Farmers always preferred a ricebean variety with high grain and good fodder yield potential. Most gave equal importance to grain and fodder yields while selecting the variety, due to the importance of livestock in the farming system. Farmers emphasized the softness and palatability of the fodder by the animals. Grain colour did not seem to be of particular importance in the preference ranking. For market purposes, the farmer-preferred traits were:

- Bold seed size
- Good taste
- Attractive grain quality
- Uniformity (no varietal mixtures)

Farmers did not prefer early accessions due to their low grain yield and very small grain size: these mature during the peak rainy season (August-September) and have a higher number of chaffy pods. However, as such genotypes may not be appropriate as commercial varieties they may have an important role as parents for breeding programmes to reduce the maturity period of ricebean. There has also been little effort so far to exploit the options offered by short duration ricebean varieties to allow short-

duration winter crop to be grown on residual moisture after the ricebean harvest in September.

Landraces with bold (large) grain, medium maturity and semi-determinate growth habit are always preferred by farmers over fodder yield (Table 9), but landraces or varieties with such traits are not available.

Table 9. Preference ranking of ricebean landraces in Nepal[†]

Traits	***Rato* (Red)**	***Seto Thulo* (White bold)**	***Khairo Thulo* (Brown bold)**	***Bhadaure***
Yield potential	1	1	2	3
Grain type	2	1	1	3
Grain colour	3	1	2	3
Maturity	1	3	3	2
Shattering	2	2	2	1
Pod size	2	1	1	3
Drought tolerance	4	1	2	3
Taste	4	1	2	3
Market potential	4	1	2	3
Rainfall tolerance	2	3	3	1
Total	24	16	20	25
Rank	III	I	II	IV

[†] Rankings are based on the scores where lowest score is best and highest is worst

Farmers in Gulmi distinguished the following important traits for ricebean when grown for food, and ranked them in the following order of preference:

1. Higher grain yield (bold seed and more pods).
2. Determinate growth habit with erect plant type
3. Synchronization in maturity of upper and lower pods of the same vine
4. Suitable for intercropping and mixed cropping
5. Medium duration (second to third week of October) and semi determinate growth habit for good fodder yield
6. Good taste and nutritional value for human health, e.g. easy to digest
7. Tolerant to drought
8. Tolerant to high rainfall during flowering
9. Low shattering
10. Disease and pest tolerance

Farmers in Gulmi ranked *Seto Thulo* as the most preferred landrace overall, followed by *Khairo Thulo, Rato* and *Bhadaure* (Table 9).

The farmers would adopt several varieties to match specific niches in the farming systems. They have clear preference for larger, bold seeded varieties with determinate growth, giving more grain and fodder yield and a plant type which is suited for growing as an inter or mixed crop with maize, sorghum or on terrace risers. Farmers ranked these landraces according to their important features. Farmers also provided positive and negatives attributes of most common types of ricebean in Gulmi (Table 10). This analysis of their existing landraces indicated that farmers might be interested in improving the taste and eating quality, grain yield, maturity and growth habit of landraces suitable for intercropping with maize, if they could also provide a reasonable fodder yield.

Table 10. Farmers' description of positive and negative traits of landraces

Name of landraces	Positive traits	Negative traits
Rato Jhilunge (red ricebean)	Somewhat tolerant to heavy rain during early flowering stage, maturing at proper time (3^{rd} -4^{th} week of October)	Not so tasty, coarse grain, lower yield
Khairo Thulo (brown large)	Tastier than red, better yield, good fodder yield	Late maturing (3^{rd} week of November)
Seto Thulo (white large)	Tasty, soft, high yielding grains, better fodder yield	Late maturing (3^{rd} week of November)
Bhadaure (early and small grained)	Early maturing (3^{rd} week of September), other crops can be grown after its harvest on the same land	Low grain and lower fodder yields, matures with maize making difficult to harvest

Ricebean marketing

Ricebean is not generally grown for commercial purposes, and there are no established markets. However, it is sold in local markets, and is often exchanged between farmers in the villages. In the study area, only 10-20 % of ricebean-growing farmers sold it either informally or in the local market. The price obtained ranged between EUR 0.29 to 0.51 per kg.

On-going studies and future prospects

We intend to carry out a systematic germplasm evaluation in four locations in 2007, using a proper protocol. The selected landraces are considered as the core collection, and some will be evaluated in mother and baby trials. As the early genotypes mature in September this could open up the option of growing short duration winter crops on residual moisture. Secondly, short duration accessions could be very valuable resource as the potential parents, especially through breeding to introduce some earliness into preferred late accessions. These genotypes will be planted as a non-core collection, and the seed will be maintained.

Although farmers have some landraces with good yield potential these do not exactly match their preferences in terms of the overall combination of traits (particularly growth habit and duration). Priority areas for the farmers are developing improved varieties, developing the market, and a better understanding of the chemical composition and nutritional quality of ricebean in order to promote it more widely. We will organise organoleptic tests for the most preferred common landraces, which will help strengthen the role of ricebean in the farming systems. If possible, we will also carry out a nutritional study of ricebean fodder, and raise awareness about it among the community, both activities also suggested by the farmers.

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