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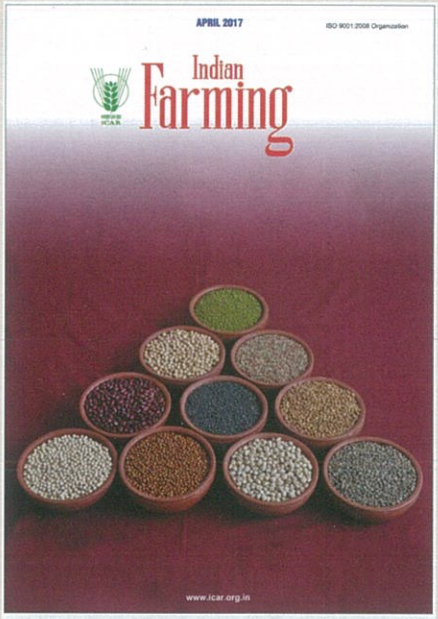

Cover I : Pulses – an essential protein nutrient in human diet.

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For editorial queries contact

Reena Kandwal
011-2584 1004, 2584 1960/610
e mail: indfarm@icar.org.in

For Subscription and Advertisement, Contact:

SK Joshi
Business Manager, DKMA, ICAR
Indian Council of Agricultural Research
Krishi Anusandhan Bhavan I, Pusa
New Delhi 110 012
Telephone: 011-2584 3657
Fax: 011-2584 3657
e-mail: bmicar@icar.org.in

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	:	$ 50	**(overseas)**

Volume 67, No. 4 **APRIL 2017**

Indian Farming

In This Issue

Indian Farming 67(04): 11–13; April 2017

Kidney Bean-A High Value Cash Crop

for nutritional and livelihood security

Anuradha Bhartiya[1], Jyoti Bajeli[2], J P Aditya[3], R S Pal[4], J Stanley[5], Sher Singh[6] and L Kant[7]

ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora, Uttarakhand 263 601

KIDNEY bean (*Phaseolus vulgaris* L.) is an important food legume popularly known as "Rajmash/Rajma" in North Western Himalayan hills. It plays a vital role in nutritional security by serving as an excellent source of protein as well as being a high value cash crop it has integral role in the livelihood security for rural and tribal populace residing in inaccessible areas of higher hills where very limited options for livelihood exists. However, its substitution by other remunerative crops in addition to a threat of gradual genetic erosion of land races from traditional agri-production systems especially in this era of climate change has been a matter of grave concern. Therefore, concerted efforts are needed to boost its production as well as to save the valuable premium quality landraces of this legume from genetic erosion.

Kidney bean (*Phaseolus vulgaris* L.) is a popularly grown high value cash crop in North Western Himalayan hills of India. It is popularly known as "*Rajmash/Rajma*" and generally grown as a major *kharif* pulse as well as in spring season. By virtue of its excellent nutritional composition it is an integral part of traditional cuisine and also serves as a source of nutritional and livelihood security to the several resource poor rural inhabitants. Farmers of this region cultivate several types of landraces of this legume and a great diversity of this food legume exists in the high mountain regions in North Western Himalayan hills. The landraces cultivated in this region has wide variation in shape, size and colours (red, maroon, brown, white, coffee coloured and spotted) and highly valued for their unique taste and fetch higher market price than those grown in the plains. Locally grown *Rajmash/Rajma* are valued for their taste, pleasant flavour and easy softening when cooked and mainly distinguished on the basis of seed testa colour. Although, *Rajmash/Rajma* is also cultivated in the plain region of India in *rabi* season but the local cultivars of *Rajmash/Rajma* grown in hills are known for their premium quality which might have resulted due to niche based climatic conditions, age old practice of farmer's selection for acceptable visual, sensory qualities along with adaptation to prevalent harsh agro-climatic conditions of this region.

Kidney bean belongs to genus *Phaseolus* and known by various names as common bean, dry beans, haricot bean, snap bean, navy bean, green beans, snap beans French/*Fras* bean, *Rajmash*, *Rajma*. Dry bean is truly a "new world crop" which originated some 7000 years ago in two different parts of the North and South American continents and its domestication resulted in the small seeded (< 40 g/100 seeds) Mesoamerican beans and the large seeded (> 40 g/100 seeds) Andean gene pools. Both the gene pools followed parallel pathways of dissemination throughout the world, generating new secondary centres of diversity in Africa and Asia and since then evolved into multiple types and are now grown and consumed in most parts of the world. It is believed that dissemination of kidney bean to Indian subcontinent probably dates back in early part of the 16th century when many Portuguese, English, Dutch and French travelled for trading via Red and Arabian Sea and Chinese through Hindustan silk route brought nicely coloured beans with them.

Globally, it is most cultivated and consumed food legume which is grown in about 29.23 million hectares with 23.13 million tonnes production and 791 kg/ha average productivity. It provides about 15% of

Himalayan hills harbour a great diversity of the food legume (kidney bean) and farmers of this region cultivate several type of landraces of Rajmash/Rajma the most common being 'Chamba', 'Barot', 'Kinnauree', 'Auli', 'Munsiyari', 'Harshil', 'Chakrata', 'Bhaderwah' and 'Kashmiri'. Presently, the production level of such a valuable crop is not as per the requirement because it is mainly grown by resource poor marginal farmers using land races with least care and inputs.

the protein and 30% of the caloric requirement to the world's population and represents approx. 50% of the grain legume consumed worldwide. Major dry bean producing countries are Myanmar followed by India, Brazil, Mexico and United Republic of Tanzania. In India, it is grown in the diverse climatic conditions with great variation in the physiographic features and agro-climates at macro and micro-level ranging from plain regions to the higher hills of Himalayas having an altitude 3000 m above mean sea level mainly in the states of Maharashtra, NW Himalayan hills (Jammu & Kashmir, Himachal Pradesh and Uttarakhand), Tamil Nadu (Nilgiri and Palani hills), Kerala (parts of Western Ghats), Karnataka (Chickmagalur hills) and West Bengal (Darjeeling hills). In North-Western Himalayan region, it is a major *kharif* crop and cultivated in the acreage of about 10.5 thousand hectare with production of about 9.8 thousand tonnes with an average productivity of about 874 kg/ha in which state of Uttarakhand contributes about 70% of total area and 75% of total production of *Rajmash/Rajma* of the region. Despite greater demand for this legume along with a potentiality of livelihood security in the region, much increase in the area of cultivation and production of *Rajmash/Rajma* is not being realized. A great diversity of this legume is maintained by farmers of this region for generations which display a wide range of seed size, colour patterns of testa as well as their specific taste, nutritional and excellent culinary properties are also under continuous threat of genetic erosion in this climate change era.

Nutritional and health benefits of *Rajmash/Rajma*

Kidney bean is the most widely cultivated and consumed food legume globally for its dry (mature), shelled (seeds at physiological maturity) and green pods. It is excellent in culinary properties as well as have high nutritional value and is regarded as an important functional food containing high levels of chemically diverse components (phenols, resistant starch, vitamins, fructo-oligosaccharides) giving protection against such conditions as oxidative stress, cardiovascular diseases, diabetes, metabolic syndrome and many types of cancer. Excellent nutritional composition of this food legume makes it a healthy, non meat protein substitute for vegetarians besides, its potential utilization in reducing the risk of several hazardous and life style diseases. Owing to its ability to substantially tolerate high altitude cold stress, it is viewed as a potential source of protein and other nutrients for supplementing the dietary needs of rural inhabitants residing in inaccessible areas in hills where limited scope exist for nutritional security. It is used for green tender pods as vegetable and as dried seeds as a pulse. It is used in various recipes and among them *Rajma-Chawal* is very popular in India. Kidney bean is rich source of protein (21.5-27.1%), carbohydrates (approx.36.1%), dietary fibre (7-20%), minerals (3.0-4.4%) and vitamins. As a matter of fact, beans are an often overlooked source of incredible medicinal benefits. It contains certain antioxidants in green pods as well as in the seed coats and beans with darker skin colour is usually rich in number of antioxidants. Kidney bean seeds are rich in soluble fibre content which regulates the absorption of blood glucose from the body besides having low glycemic index. Thus, regular consumption of kidney beans can help in preventing diabetes. It also contains thiamine which plays a significant role in enzymatic reactions of energy production and is critical for cognitive functions of the brain and thus, it's intake is beneficial in evading age-related impairment in mental function (senility) and Alzheimer's disease. The green pods contain an appreciable amount of antioxidants, carotenoid and flavonoids (like lutein, zea-xanthin and ß-carotene) which have anti-inflammatory actions. Fresh green beans have very low calories but rich in dietary fibre and folates which act as a bulk laxative and good folate diet during preconception and during pregnancy helps to prevent neural-tube defects in the new born babies.

Rajmash/Rajma based traditional cultivation practices in NW hills

Cultivation of *Rajmash/Rajma* is well suited to hill ecosystem where this crop entirely grown under organic rainfed condition and most of

Farmer's field view of Harshil *Rajmash/Rajma* cultivation (2a) and post harvest activities (2b, 2c & 2d) at an altitude of 2500m amsl in Uttarakahnd

the hill farmers practice subsistence cropping systems. Traditionally, indeterminate trailing type *Rajmash/Rajma* landraces are grown during *kharif* in North Western Himalayan hills. However, it can be profitably grown in spring season too with bush type cultivars in this region. Farmers generally grow 10-12 landraces together for their own consumption and only a little surplus come to the commercial market. In the traditional production system this legume is grown in rotation with vegetables, wheat, barley and sarson and intercropping of climbing/pole type *Rajmash* with grain amaranth and maize during rainy season in the hills as an insurance against harsh and unpredictable weather conditions. In Himachal Pradesh hills, maize + *Rajmash*, potato + *Rajmash*, cabbage + *Rajmash* and apple + *Rajmash* intercropping system is generally followed. *Rajmash/Rajma* is a component crop in popular "*Barah Anaaja*" system of traditional mixed cropping practiced in Uttarakhand hills, in which seeds of twelve food grains are mixed and grown. Culture of "*Barah Anaaja*" is a unique example of cultivating agro biodiversity and raising food security by rural and tribal inhabitants in hills. Intercropping of *Rajmash/Rajma* along with potato is emerging as most profitable system in mid hill conditions. *Rajmash* is a highly productive and input responsive crop suitable for intensive cropping system. In Northern plain region generally, bush types cultivars are grown as sole crop during winter season and high yields are obtained under better management conditions.

Improved *Rajmash/Rajma* varieties recommended for cultivation

Rajmash/Rajma grown in hills has great demand but the use of local poor yielding cultivars with poor standing ability and susceptibility to many diseases such as root rot, bacterial blight, rust, anthracnose, angular leaf spot and insect-pests like, pod borer, aphids, leaf miner, semilooper, cutworms *etc*. renders poor production and productivity of this food legume. Keeping these aspects in view an improved *Rajamsh/Rajama* varieties have been developed by ICAR-VPKAS, Almora which is well suited for cultivation under rainfed organic conditions with overwhelming superiority over traditional landraces as well as fair degree of resistance against diseases and insect pest prevalent in hills.

VL *Rajma* 63: This bush type and light red with deep red patches grain coloured *Rajmash /Rajma* variety has been released by State Variety Release Committee for timely sown rainfed organic conditions of Uttarakhand hills. VL Rajma 63 was developed though selection from local germplasm of Uttarakhand hills. It has an average yield potential of 10-12 q/ha with the maturity period of 70-75 days.

VL *Rajma* 125: It is a bush type, high yielding *Rajmash//Rajma* variety suitable for cultivation under rainfed timely sown organic conditions of Uttarakhand hills. It has been developed from the cross PI 339482 x EC 9160-3 and released by State Variety Release Committee in 2007. It has an average yield potential of 11-12 q/ha with the maturity period of 73-98 days. This white grain coloured variety has resistance against bacterial blight and root rot.

SUMMARY

Rajmash/Rajma is a major high value cash crop in NW Himalayan hills. It is economically, nutritionally and socially an important crop in high mountains of this region in traditional production system in hills. Presently, farmers grow landraces of this food legume for their own consumption and a little surplus only reaches to the markets. Here a vast potential exist for this food legume for its commercial cultivation as this premium quality *Rajmash/Rajma* landraces are highly adapted to the local microclimatic conditions of the limited geographical area and well appreciated for their unique taste and fetch 2-3 times higher market prices than those produced in plains as well as possess the advantage of pure organic farming. Besides, conservation and documentation of these landraces is also a great concern. Commercial cultivation by using improved high yielding varieties with recommended package of practices will ultimately uplift the livelihood of the local *Rajmash/Rajma* growers of hills.

[1,3,4&5]Scientists, [2]SRF, [6]Senior Scientist and [7]Principal Scientist, ICAR-VPKAS, Almora, Uttarakhand, [1]e-mail: *anuradhagpb@gmail.com*

Attention authors

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