July 2001 Vol 2 No.1

BEANSTALK

Centre For Legumes In Mediterranean Agriculture Newsletter

Indo-Australian Chickpea Project

■ **by Jens Berger, CSIRO**
j.berger@ccmar.csiro.au

The ACIAR project 'Traits for yield improvement of chickpea for drought-prone environments of India and Australia' was recently reviewed in both countries. The review began in Brisbane on 23 February, where some of the Australian collaborators (Kadambot Siddique, Neil Turner, Jens Berger, Ted Knights, Bob Brinsmead) outlined the progress over the last two seasons to our Australian reviewer, Dr Glenn McDonald (Dept. of Plant Science, Adelaide University), and ACIAR's Crop Science Manager, Dr Colin Piggin.

Some of the review team enjoying Rajasthani hospitality in Jaipur.

After a long day in Brisbane we left Ted and Bob to return to Tamworth and Warwick respectively, and made our way to New Delhi, where we were joined by our Indian reviewer, Dr Vijai P. Singh, (Haryana Agricultural University). To take full advantage of the timing of our visit we ensured that the Indian review combined visits to the field as well as more formal meetings and presentations of results. What ensued was an extremely hectic seven days spent travelling around northern India on all manner of planes, trains and automobiles! Our first port of call was the green fields of the Indian Agricultural Research Institute in New Delhi, where we inspected the project's physiology and genotype by environment trials, as well as a small portion of Dr Yadav's diverse breeding material. After formal meetings with Dr Mangala Rai and Dr N.B. Singh from the Indian Council of Agricultural Research (ICAR), the review team headed for Rajasthan for a first hand look at chickpeas coping with drought, and were extremely privileged to also experience the famous Rajasthani hospitality.

"a lack of data to discuss is not one of our problems"

From Jaipur we spent a harrowing time using all three modes of transport to reach Kanpur, for the culmination of the review, hosted by the Indian Institute of Pulses Research (IIPR) which coordinates the Indian side of our project. It was a day of long speeches! With seven collaborating institutes in India, and five in Australia, a lack of data to discuss is not one of our problems! In the morning we were welcomed by Dr Masood Ali, Director IIPR, and given an overview of the project and chickpea industry by Profs. Siddique and Turner. This was followed by a review of the Indian physiology and G x E research, and then representatives from all collaborating institutes presented the highlights of their work during the life of the project. Finally, the performance of the chickpea genotypes across India and Australia was summarized by Dr Berger, and potential future directions indicated by Prof. Turner.

All in all it turned out to be a very long, but extremely rewarding day, as many of the presentations resulted in lively discussion by reviewers and collaborators alike. Because our project aims to explain adaptation in chickpea using the G x E approach across a range of traits there is always plenty of room for robust discussion. Presenting evidence as to why particular genotypes do well under some conditions and poorly under others, in a room full of breeders and physiologists is a recipe for interaction as people's pet theories are challenged or supported. All in all a million miles away from dryly presenting lists of averages across sites!

The review team and project collaborators in the field at Kanpur.

It was clear that the reviewers were very impressed by the sincerity shown by the project collaborators and enjoyed the robust exchanges. At this stage we are eagerly awaiting their feedback, through the review process, to see what the future holds for the program.

Announcement

Lupins in Iceland

The 10th International Lupin Conference will be held in Iceland in 2002. You can find further information on the conference homepage: **www.rala.is/lupin**

Workshop

Bio-security

Counting the Cost of Agricultural Disease & Pest Management
13 & 14 August 2001, Sydney.
This conference is receiving official support from the National Farmers Federation and The Australian newspaper. For information email Steven Cronshaw
scronshaw.acr@bigpond.com

From The (new) Director

Recently I joined CLIMA as Director. My vision is to lead the Centre to become a Centre of Excellence in pulse and annual pasture legumes with a WA focus, but with strong links with other national and international organisations. This will be achieved through the conduct of strategic research linked to an applied base. The Centre will build on the national and international linkages already established and will build its reputation as a world leader in problem–focused legume research.

It is essential that CLIMA be up to date with latest, worldwide developments in research and technology to help the nation's growers and industry remain competitive in the global grains market.

For those of you who don't know me, I have more than 20 years experience in crop physiology, production agronomy, germplasm enhancement, breeding, market research and industry development of pulses and cereal crops in Australia and overseas. I also have an intimate knowledge of CLIMA, having been closely associated with the Centre since its inception.

My role is to manage the Centre and to drive strategic research planning for the development of pulse and annual pasture legume industries in WA. The Centre will focus on research projects that will help deliver superior quality varieties and products of legumes that are disease and insect resistant and high yielding, in partnership with relevant crop and pasture breeding programs in Australia. The Centre will also develop information and technology that will assist the development of improved management packages for pulse crops and pasture legumes for WA farming systems. The Centre will actively communicate the research outcomes to the industry through its partner organisations and private consultants.

Some of my immediate priorities are:

- Review the cooperative research arrangements between the CLIMA partners (AGWEST, UWA, CSIRO and Murdoch University) and identify where these arrangements can be further strengthened.
- Develop the structure (governing board, administrative and scientific) of the Centre and nominate research program leaders to coordinate the research and communication efforts currently being undertaken and to identify new opportunities.
- Revitalise the research strategic environments in legumes in WA by talking with all concerned (especially the Centre staff and scientists from partner organisations) ensuring that the work is focused, well coordinated and all players are included and well motivated.
- Develop new and innovative means of research funding (new sources) as well as strengthen funding arrangements with traditional funding bodies (e.g GRDC).
- Develop a 5 year strategic research and business plan (including commercialisation) for the Centre.

I am confident about the future of CLIMA and look forward to working with you all in facing the challenges ahead. Please contact me if you would like to discuss any aspect of your work or suggestions for the future directions of CLIMA. My office is located in the CLIMA building upstairs (Room number: 1.144).

Adj/Prof KHM Siddiquue
ksiddique@agric.uwa.edu.au

Summary of the Lathyrus Workshop

■ **by Colin Hanbury, CLIMA**
chanbury@cyllene.uwa.edu.au

A workshop in May brought together researchers, GRDC growers and potential end-users of Lathyrus. This enabled results on crop growth, adaptation, end-uses and future developments in agronomy, animal use and other areas to be discussed

Background:
Recent studies undertaken through CLIMA indicates that grain legumes *Lathyrus sativus* and *L. cicera* have shown good adaptation to large areas of southern Australia. These legumes have a long history of cultivation across Europe, the Middle East and southern Asia as human and animal feed. However, in the last half of the twentieth century they have become minor crops, except *L. sativus* on the Indian sub-continent and in Ethiopia. No appreciable quantity of Lathyrus has been previously grown in Australia.

The soon to be completed GRDC project entitled 'On-farm use and industry development of Lathyrus in Australia (UWA 287)' had 3 aims:

i) In cooperation with grower groups, to identify the role of Lathyrus in southern Australian dryland farming systems and fine tune production packages.
ii) To develop animal feed and/or human food markets for Lathyrus both within Australia and overseas.
iii) To select Lathyrus cultivars with improved yield and quality from existing early generation breeding lines.

CLIMA has released one cultivar of *L. cicera* (cv. Chalus) and a cultivar of *L. sativus* is anticipated. A range of animal feeding studies have been completed to assess suitability of cv. Chalus to both on-farm animal feeding and monogastric feed compounding. Agronomy of Lathyrus has been studied extensively in WA and Vic. The role of Lathyrus in the on-farm situation has been trialed in WA, SA and Vic in the low-to-medium rainfall areas. Some of the benefits of Lathyrus have been shown to be: high seed protein content and good quality animal feed, absence of serious disease, high N levels as green manure and adaptation to low rainfall areas.

LUPINS TOO THICK-SKINNED?

■ by Jon Clements, CLIMA
jclements@cyllene.uwa.edu.au

Selection for thinner seed coats and pod walls in *Lupinus angustifolius.*

Lupin grain quality needs to be improved to increase its market value. High indigestible fibre is one of the biggest limitations and most of this fibre is in the seed coat. We have selected genotypes with less seed coat and these will contribute to lowering indigestible fibre in lupin grain. We have also selected genotypes with less pod wall and these could improve grain yield through more dry matter being transferred to the grain. These lines are being included in the lupin breeding program.

Lupins are used mainly as a source of protein for pigs, poultry, sheep, cattle and fish. About 1.5 million tonnes of lupins, worth $A 200 million, are produced annually in Australia. They are sent to feed markets in Northern Europe and expanding markets of South East Asia. The value of lupins is constrained by very hard and thick hulls with high indigestible fibre and low metabolisable energy, particularly for non-ruminants. De-hulling lupins can improve digestibility but costs around $60 per tonne.

Research work at CLIMA by Jon Clements and Miles Dracup (Fig. 1) aims to raise metabolisable energy through reducing the proportion of grain weight in the seed coat of narrow-leafed lupin.

Narrow-leafed lupins also retain 32% of pod dry matter in the pod walls, and reducing this is expected to increase seed yield. Lowering pod wall proportion is therefore another project aim.

Variation for seed coat and pod wall proportion has been sought among a large range of *L. angustifolius* genotypes including approximately 10,000 mutant lines and 800 wild, semi-domesticated and breeding lines. Ten new genotypes have been identified with 15 - 20% less seed coat compared to cv. Tanjil. One of these shows a 23% reduction in seed coat thickness relative to the parent genotype (see Fig. 2) and lower fibre and higher oil. Five genotypes with 15-18% less pod wall than Tanjil have also been selected. These lines include a wild genotype from Patmos Island, Greece, collected by Associate Professor Wallace Cowling who is also collaborating on the project. With some of Dr Nick Galwey's expertise, a detailed genotype by environment analyses has been carried out on 5 years data and this has shown that among breeding lines there is a strong genetic component for seed coat and pod wall proportion and that the traits can be reliably selected for across environments.

Fig. 1. Jon Clements and Miles Dracup with plants and seed of a thin seed coat genotype of narrow-leafed lupin

We hope the genotypes selected will contribute to lowering indigestible fibre in lupin grain and improve yield through increasing dry matter transfer to grain. Crosses with standard lupin varieties are at F_4 stage and will be in preliminary yield trials next year in collaboration with senior lupin breeder, Dr Bevan Buirchell, at Agriculture Western Australia.

The project is also attempting to develop a rapid screening method for selecting thin-hulled lines in collaboration with the Optical+Biomedical Engineering Laboratory led by Assoc. Professor David Sampson who use optical coherence tomography in a range of applications including detecting skin cancers. The collaboration will try to apply this technology to rapidly measuring seed coat thickness. Near infra red technology will also be investigated as an alternative. In addition, work has begun to identify molecular markers for thin seed coats in collaboration with Assoc. Professor Wallace Cowling, Dr Michael Francki and postgraduate student Daniel Mullan.

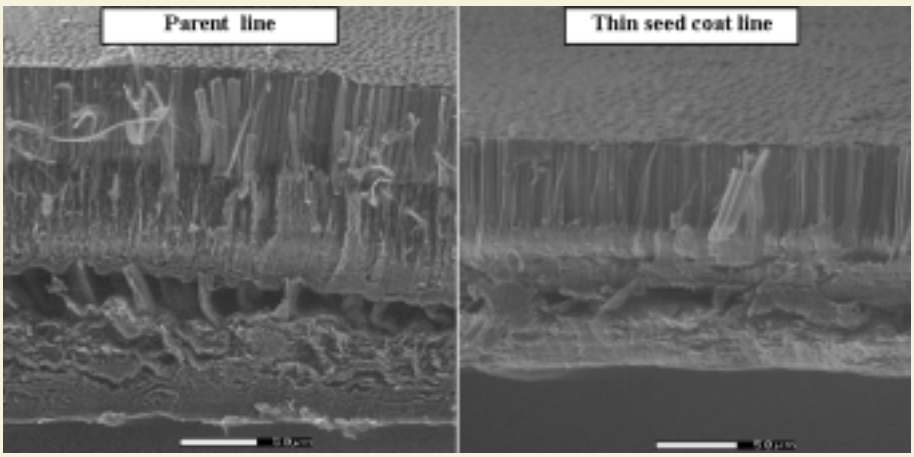

Fig. 2. Scanning electron micrographs of parent and thin seed coat lines of lupins. (scale bars represent 50 mm).

Economic History of Pulses

■ by Nancy Longnecker, CLIMA
longneck@cyllene.uwa.edu.au

Note: *This article was written for a general audience. Apologies to those who know most or all of this information. The article may be of interest to some readers. Author, Nancy Longnecker.*

Pulses are a major source of protein in diets of many people around the world. In ancient cultures, pulses and cereals developed as traditional companions. Combinations such as beans and tortillas or dhal and naan bread still provide the basis of delicious meals evocative of the cultures from which they come. Pulses are plants from the legume family grown for human consumption, including beans, chickpeas, lentils, peas and lupins. Because pulses have an association with beneficial soil bacteria that 'fix' nitrogen from the air, they are high in protein and thus nutritious to eat. They also improve the soil in which they are grown.

Origins of Pulses in Agriculture Long before the Industrial Revolution, the Neolithic Revolution of human civilisation occured with the transition from hunter-gatherer to agriculture, allowing development of diverse human talents and necessitating social evolution. Abundant wild relatives of the cereals wheat and barley permitted settlement in the Near East and thus encouraged plant cultivation – probably by women who had been the main gatherers. Cultivating wheat and barley for food began about 8500 BC in the Fertile Crescent. Within a millenium, peas, lentils and chickpeas had been added to the repetoire.

Farming developed independently in Latin America and Asia with a similar outcome being the combination of cereals and pulses. Beans were cultivated in Mexico and Peru by about 6000 BC and beans and corn are still the mainstay of the diet of much of Latin America. In China, millet predated rice as the first main crop and soybeans were grown by about 3000 BC.

Legume Legends There are numerous recorded examples which illustrate the importance of pulses in early history. Pulses played a role in some of the religious observances of the ancient Egyptians. Beans (probably *Vicia faba*) were offered to the dead during the earlier dynasties and lentils were sacred to Harpocrates, the Egyptian personification of silence. The Greek historian Herodotus reported that the builders of the Giseh pyramids ate lentils, perhaps aware of their benefit (from high protein) for such arduous labour; Athenians celebrated a Feast of Beans, the Kyampsia, in honour of Apollo. One of the best known ancient references

to pulses is the Biblical pottage of red lentils which Jacob used to buy his brother Esau's birthright. The importance of the chickpea and lentil on the Indian subcontinent is intertwined with the vegetarian principle required initially by Jainism, encouraged by Buddhism and then taken up by brahmin priests of Hinduism.

Pulse Food Pulses have obviously been traded widely as evidenced by the use of many of the beans, which originated in the Americas, in traditional foods in Europe and Africa and the dominance of chickpeas and lentils, which originated in the Near East, in the traditional diet of the Indian subcontinent. Peas, which originated in the Near East, are found in traditional foods around the world, even reaching the heights of the Himalayas.

Ancient people may have noticed that eating combinations of pulses and cereals resulted in improved vitality because the combination provides an excellent supply of 'complete' protein. As with many things, the scientific explanation – that pulses are deficient in sulphur-containing amino acids methionine and cysteine but have good lysine levels, while cereals are conversely short of lysine but relatively rich in methionine – came much later. However combinations of pulses and cereals are found in diets throughout the world. Varied and exotic images come to mind when we think of combinations such as hommous (chickpea) and pitta bread, beans and tortillas, tempeh (soybean) and rice, lentil dhal and naan bread, chickpeas and pasta, pease pudding and rye bread and even baked beans on toast.

Pulses in Crop Rotations The association between legumes and the bacteria which colonise legume roots is mutually beneficial. Enzymes from the bacteria are capable of breaking apart nitrogen atoms of nitrogen gas (N_2) which makes up about 80% of the earth's atmosphere and 'fixing' nitrogen for the legume plant. This benefits not only the legume plant but other plants which grown in that soil after the legume plant dies and decomposes. Without this association or symbiosis, plant productivity would be extremely low and life on our planet would be very different. The scientific explanation of this special role of legumes and their associated bacteria, came relatively recently by the German scientist Hellriegel in a report in 1888 which was rapidly confirmed by other European and North American scientists. However, the value of legumes for improved growth of other crops has been known for over a millenium.

Green manuring of legumes, where the legume is ploughed into the soil to enrich it for the next crop, was a practise reported by Ts'i Min Yao Shu, a Chinese writer of the fifth century BC. The Greeks also practised green manuring; Theophrastus (370-285 BC) reported ploughing beans under in Thessaly and Macedonia. Roman writers have left a substantial written record of their agricultural practises and the Roman agriculturalists and writers who extrolled

• continued

the virtues of legumes in crop rotations included Cato, Varro, Columella, Pliny and Virgil. In his Georgics (30 BC), Virgil recommended "where you have reaped the legume with shaking pod, the vetch and lupine, sow your wheat..."

With the decline of Rome came a lull in the recognition of the benefits of legumes in crop rotations, but in Charlemagne's empire in the Middle Ages (800-814 AD), legume rotations were reportedly introduced to the farming system and society became 'more forceful'(Tannahill, 1988), probably because of increased protein in the diet.

In modern times, the legume soybean is one of the major crops grown and traded in the world. In North America, it is grown in crop rotations but not for its nitrogen fixing ability. Instead, soybeans are generously fertilised with industrially-fixed nitrogen fertiliser. Of the developed countries where agriculture is an important part of the economy, Australia is relatively unique in its reliance on nitrogen fixed by legume crops (pulses) and pastures.

Health Benefits of Pulse Consumption Undoubtedly one reason for the historical importance of pulses in human diets has been their high protein content (mostly 20 to 25 per cent but 36 per cent for soybeans, compared to 10 per cent or less for most cereals). Pulses are also high in fibre and carbohydrate and low in fat (except soybean). They have no cholesterol or gluten, a low glycemic index, high amounts of nutrients such as iron, calcium, magnesium, potassium and trace elements such as copper, zinc, selenium and manganese and vitamins such as the B group vitamins, thiamine, niacin and folate. They also contain phytonutrients including antioxidants and compounds with oestrogenic activity thought to help in prevention of hormone-related cancers like breast and prostate cancer and to reduce problems related to menopause such as osteoporosis. Some of the health benefits of pulses are supported by clinical or epidemiological data, but many are anecdotal or extrapolated from other observations.

Because of high protein, pulses have been considered 'poor man's meat' and are still important dietary components for people who are vegetarian for philosophical or economic reasons. Because of other characteristics, pulses are credited with additional health benefits in developed countries where protein deficit is rarely a problem. Because of the delicious combinations available from this diverse group of plants, they remain popular on menus around the world.

Other reading:

Diamond, Jared. *Guns, Germs and Steel. A Short History of Everybody for the Last 13,000 Years*. Random House. 1997.

Harris and Hillman. *Foraging and Farming: The Evolution of Plant Exploitation*. 1989.

Longnecker, Nancy. *Passion for Pulses: A Feast of Beans, Peas and Lentils from Around the World*. The University of Western Australia Press. 1999.

Smartt, J. *Grain Legumes: Evolution and Genetic Resources*. Cambridge University Press. 1990.

Tannahill, Reay. *Food in History*. Penguin Books. 1988.

Zohary, D. and M. Hopf. *Domestication of Plants in the Old World*. Oxford: Clarendon. 1988.

Annual NAPLIP Pasture Tour in September

■ **by Angelo Loi, CLIMA**

angeloi@cyllene.uwa.edu.au

Dates have been finalised for the Annual NAPLIP (National Annual Pasture Legume Improvement Program) Pasture Tour. The tour will run from Monday 10 September - Friday, 14 September.

Each year NAPLIP (National Annual Pasture Legume Improvement Program) organizes a pasture tour in one of the Australian states involved in the program. The aim of this annual tour is to:

- facilitate the exchange of scientific information, development of new strategies for the selection of new species/cultivars and innovative agricultural systems.
- visit current field experiments
- visit the state's larger seed producers of annual pasture legumes
- visit leading farmers using annual pasture legumes in their farming systems, in areas of contrasting climatic conditions and soil types.

Personally, I believe this is one of the most efficient and enjoyable ways to confer with researchers of the highest expertise in their related fields, and be exposed to and learn first hand about new technologies and ideas.

This year the tour will be held in Western Australia and will provide all participants with the rare opportunity to witness legume–based farming systems being practised in areas of diverse climates and soil types.

The development and introduction of new alternative pasture legume species by CLIMA has generated a strong demand for the development of innovative and more sustainable systems using annual pasture legumes.

> "this is one of the most efficient and enjoyable ways to confer with researchers"

The areas to be visited include Medina, Brookton, Pingelly, Tincurrin, Cunderdin, New Norcia, Kalannie, Mingenew, Geraldton and Badgingarra. The itinerary will also include a visit to one of the largest seed producers in the state, Ballards Seeds (WA winners of the 1999 CLIMA Award of Excellence).

The cost of the 5 day tour will be approximately A$500.00 and spaces are limited. Confirm your place on the tour as quickly as possible with me via email (address at start of article). It is important to confirm your attendance as soon as possible as the tour will be held during the peak wildflower season.

The Dryland Salinity CRC Gets Under Way

■ by Phil Cocks, CLIMA
pcocks@cyllene.uwa.edu.au

As most of you know the CRC for Plant-based Management of Dryland Salinity (already shortened to the 'Salinity CRC') was successful in the 2001 round of CRCs. Since January, when it heard of its success, the management team has been active in preparing agreements and planning research. The Interim Board has met in Adelaide and Melbourne, and the first meeting of the legally constituted Governing Board will be held in Sydney on August 8th.

The CRC will work on the subject of dryland salinity and how we can use plants to manage it. Dryland salinity is caused by the removal of the old perennial native vegetation and its replacement by annual crops and pastures. The annuals cannot use all the rainfall, and the water leaks into the saline ground water, which, as a result, comes to the surface. To be successful the CRC needs to lead the replacement of as much as 30% of the annual vegetation with perennial vegetation.

"To be successful the CRC needs to lead the replacement of as much as 30%"

The research program will operate under two philosophies. The first is that we intend to learn from the way natural ecosystems work and use this information to develop land use systems more in tune with the Australian environment. The second is that whatever land use system we advocate must be profitable to land use managers. It is only in this way that we believe we can get change on the scale needed.

There will be six programs: education, information exchange and technology adoption; function of natural and agricultural ecosystems; new and better varieties of woody and herbaceous perennial plants; land use systems with balanced water use; and economic and social assessment. Our Program Leaders contain names familiar to people from CLIMA: Mike Ewing who will head Program 3 (new and better varieties), and Dave Pannell who will lead Program 5 (economic and social assessment). Other Program Leaders are from CRC partners in South Australia and New South Wales.

Of particular interest to CLIMA collaborators is the work we intend doing on perennial legumes. In its last few years staff and students in CLIMA commenced work on selecting alternatives to lucerne, and this work will be continued in the Salinity CRC. Already, in our planning meetings, we have found new links in New South Wales and Victoria. Of most interest is *Lotus corniculatus*, a widespread species from Eurasia, North America and north Africa. We will maintain and expand the perennial legume network established at Perugia in 2000 and establish links in central Asia and North and South America.

Of course, our work will go far beyond the perennial legumes. Of interest to our herbaceous perennial work is the concept of growing perennial grasses with annual legumes. We will also be looking at perennial crops. There will be a great deal of work on woody perennials, such as oil mallees and melaleucas, and crops such as guayule.

While the CRC will begin officially in July 2001, most of 2001/02 will be spent planning. We have an ever expanding group of collaborators and we want all of them to have their say. It is also important that we get our research program right. Time spent planning now is invaluable.

Although this early stage of the work is at times difficult and I sometimes think involves mainly crisis management, it is truly exciting and rewarding. We believe that our CRC will have an impact on dryland salinity, which is undoubtedly the major environmental problem facing Australia.

Warm Up Winter

Thai-Style Stir-Fried Green Beans and pork (*Nam Prik*)

Asian Cooking incorporates distinctive and opposing flavours, which create a taste sensation. This stir-fry is a delicious example.

Total Preparation time 40 minutes
Hands-on: 35 minutes
Hands-free: 5 minutes
Serves 4 - 6

Recipe tip: If making larger quantities of this dish, cook the pork in small batches.

500 g green beans
4 tbsp peanut oil
1 clove garlic, crushed
1 tbsp fresh ginger, chopped
250 g pork, minced
1/2 cup (125ml) chicken stock
1 tbsp soy sauce
2 tsp oyster sauce
1 tbsp fish sauce
Juice of 1 lime
2 tsp cornflour
1 spring onion, sliced at an angle

Wash, top and tail beans; cut into 5 cm lengths. Blanch in very hot water for 1 minute; rinse under cold water and set aside.
In a very hot wok, saute garlic and ginger biefly in oil.
Add pork. Continue to saute, tossing pork around constantly until it is nicely browned.
Add chicken stock, soy sauce, oyster and fish sauces, and lime juice. Allow to simmer gently for a few minutes.
Mix cornflour with 1 tbsp cold water; add to wok and stir until sauce thickens.
Add beans; heat through.
Remove from heat; stir through spring onion.
Serve with steamed rice.

Report launched at CRC Association Conference in Perth

■ by Amir Abaddi,
Touchstone Consulting
office@touchstone.millstream.com.au

"An Assessment of the Impact of CRC Investment in CLIMA" is the title of the report by Amir Abadi, Mike Ewing and Nancy Longnecker which was launched in May, 2001 at the annual CRC Association Conference.

The report assessed and summarised the impact of the collaborative research, extension efforts and educational activities of CLIMA during its CRC phase. Amir in particular asked the following questions of sub-program and program leaders and other key participants:

- Did CLIMA attract more external and industry funding and 'broaden its funding base', thus leveraging its Commonwealth funds?
- What kind of outputs were associated with CRC legume research, extension and education?
- What proportion of those outcomes is attributable to the existence of the CRC as distinct from the collective effort of the researchers involved?
- What was the nature and extent of collaboration at the CRC between individuals, between the sub-programs and between the CRC and other national or international institutions.

Results

The study documents many findings, including:

- CLIMA's management and administrative structure created an environment conducive to collaborative research.
- CLIMA attracted 4.5 dollars for every CRC dollar invested by the Commonwealth. It attracted 1.7 dollars from competitive research grants per dollar of CRC invested. Industry contributed about 23.5 million dollars in cash through the funding of various projects and the partners contributed about 38.9 million dollars of in-kind contributions and 0.85 million dollars in cash contributions.
- Between 1992 and 2000, CLIMA had 66 full-time PhD students, most of whom were co-supervised by non-university staff. There were 27 non-university supervisors of PhD research. As of 2000, there were 34 PhDs awarded. This PhD support effort was maintained by a CLIMA professional research staff of about 60.
- CLIMA has commercialised several products. Commercialised products include pulse and pasture varieties and knowledge products such as books and training courses. CLIMA has released or will release approximately 37 commercial varieties of legume crops and pastures.
- CLIMA staff generated over 1250 publications ranging from refereed journal articles and books to extension articles in rural and trade magazines. Seventy-eight per cent of these publications were co-authored.
- 80 CLIMA workshops, short courses, symposia and conferences were held between 1992 and 2000, with over 3500 participants (excluding major conferences to which CLIMA provided sponsorship eg the International Cool-season Food Legumes Conference in Adelaide). Three CLIMA workshops resulted in international publications of the proceedings. Twenty-six workshops were organised by CLIMA postgraduate students.

Conclusions

CLIMA's commitment to a flat management structure, its communication strategies, the collaborative culture prevailing among its staff and students and its education and training policy produced and will continue to produce a stream of benefits that are hard to measure but will have long-lasting effects on the industry.

- CLIMA was a successful CRC which fulfilled the objectives of the Commonwealth CRC Program funding.
- CLIMA demonstrated the benefits of research cooperation to its partners and the industry.
- CLIMA is committed to high quality collaborative research and education and has established national and international links that will provide a long-lasting flow of benefits to the agricultural industry.
- CLIMA effectively delivered its education objectives. This is indicated by the number of PhDs enrolled and graduated, the number of well-attended industry and university training courses offered and the production of innovative teaching and learning resources.
- CLIMA has been a key player in the development and release of a significant number of innovations such as crop and pasture varieties as well as knowledge products. There are clear indications that a majority of these products will have economically important roles in the Australian farming systems.
- CLIMA demonstrated a high degree of flexibility. It managed to quickly and successfully respond to major disease outbreaks in the legume industry while it remained committed to its strategic direction of producing innovations required by the industry for long-term profitability and sustainability.

Copies of the report are available from the CLIMA office,
call:(08 9380 2505),
email: clima@cyllene.uwa.edu.au

Postcard from Hanoi

It seems a lifetime since I was at UWA but it's really just less than 1 year. Last year was spent at The University of Sydney as a Research Fellow for an ACIAR-funded project 'Impacts of alternative policy options on the agricultural sector in Vietnam'. This year I'm based at Hanoi Agricultural University while we do the data collection needed for the economic modelling component of the project.

Vietnam has been implementing economic reforms in relation to agricultural production for over a decade and these new government policies have had significant impacts on agricultural production as well as overall economic growth. However, the impact of policies at the household level has had very little investigation. The models being developed will allow us to examine policy changes for their effect on land use, production, household income, labour use, etc. at the household level.

I've also been doing some work with Ivan Kennedy (SUNFix Centre) and his collaborators at the Hanoi University of Science looking at the economics of their inoculant biofertiliser technology. As for legumes - there are plenty here, but I don't recognise half of them! Worse still - I don't know how to prepare and cook them as well as the Vietnamese. Guess I'll just have to keep on eating out. Living in Sydney was great, but living in Hanoi is something else again. Vietnam is a vibrant country that just engulfs you. So far I'm surviving the traffic, loving the city, the people and the food, and being constantly challenged by the work and fascinated by the agriculture.

Hen gap lai,
Sally Marsh

Newsletter Credits

© CLIMA 2001, The University of Western Australia, 35 Stirling Highway, CRAWLEY WA 6009
Vol. 2 Number 1 July 2001
Editor: Dr Nancy Longnecker
Contributing Authors:
Dr Amir Abaddi
Dr Jens Berger
Dr Jon Clements
Prof Phil Cocks
Dr Neil Emery
Dr Colin Hanbury
Dr Nancy Longnecker
Ms Sally Marsh
Prof KHM Siddiquue

For newsletter details, layout design etc. Contact: Citrus Design: citrus@squeeze-me.net

Postcard from Peterborough, Ontario, Canada

After spending 1994-98 at the hormone physiology lab of CLIMA I moved to Dijon, France and the Institut Nationale de la Recherche Agronomique - no, not to work on mustard - to study source-sink and water relations in pea. I helped to complete a large scale isotope labelling chamber and tracked the acquisition and movement of N and C following separate root (15N2, 15NO3) and shoot (13CO2) labellings. Unfortunately, my progress was hindered by frequent visits down the Burgundy wine cÙte.

Following that, a real challenge was needed - so Jill and I looked at the list of top 3 stressful life events (change in career, moving house, having a baby) and made up a package. In November 2000 we moved to Peterborough, I took up an assistant professorship at Trent University and our daughter, Frances Marion, was born (Dec 12 a sister for Laurence Flinders now 2.5 yr old).

Thanks to my CLIMA roots, I was shown the way, and my research program at Trent is still legume focussed. Thus, I would value keeping my contacts with my CLIMA friends strong.

Neil Emery
Ontario, Canada

CLIMA Was There

One of CLIMA's activities during National Science Week (NSWk) was a national competition for school children, The Great Grains Cook-off, run as part of the GRDC-funded Bean Files. Students at Jolimont Primary School in Perth judged the taste, smell

and colour of the recipes, ranging from 'disgusting' to 'yummy'. The winning recipe was Oatmeal Pancakes, submitted by 10 year old Patricia McLarin, grade 5 of Lindisfarne Primary School, Tasmania.

CLIMA and the Centre for Rhizobium Studies combined forces to put up and staff a display at the Brain Fuel Expo in Forest Chase. In his role as Science Minister, Premier Geoff Gallop launched NSWk at the Expo which was funded by the Department of Commerce and Trade in order to highlight excellent science and technology in Western Australia.

The finale of NSWk was UWA's Open Day and CLIMA had a display as part of the Faculty of Agriculture's tent. Although foul weather kept the numbers down, the visitors who came were keen and impressed with the variety of high quality science on display.