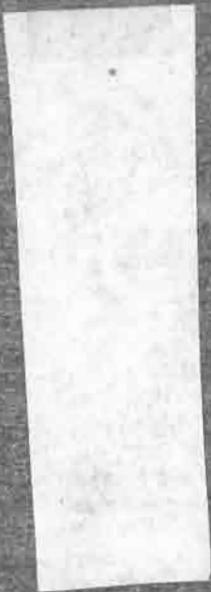


green revolution



'Miracle seeds' are now beginning to double and treble the yields of food crops all over the developing world. To the people of Africa, Asia, and Latin America, they have brought the hope of an end to precarious subsistence farming.

To Dr. Norman Borlaug, they have brought the 1970 Nobel Peace Prize and the title 'Father of the Green Revolution'.

In this exclusive interview, Borlaug talks about the implications of his life's work and hits out at his growing number of critics.

Dr. Borlaug was interviewed in New Delhi by Peter Adamson

INTERNATIONALIST: Dr Borlaug, you and your team have received many awards for your work on the "Green Revolution", but now you're also getting a lot of criticism.

BORLAUG: We have an abundance of critics who sit in their offices, air-conditioned very often, all around the world, who say this so-called green revolution is just a figment of the imagination!

For example, in the pre-green revolution year 1965, the wheat production here in India increased from 12 million metric tons to 12.3 million metric tons—and that was a very good year. Last year they harvested 20 million metric tons! But this has been explained away by some of the critics who say it was just a streak of good weather!

This is ridiculous. But yet it's written up in some magazines by scientists who are supposed to know better.

On top of that, we've got the wildly purist ecologists on our necks now. Since we use heavy rates of fertiliser we must be contaminating all the streams and rivers and adding to the pollution problems all round the world, and besides that we use these awful pesticides! To them, I would only say this—if you deny these people the use of chemical fertiliser (not just in India but all over the developing world), then you commit them to hunger and famine and starvation. And is this what the conservationists are trying to conserve?

So long as the ecologists are reasonable in their approach, I'm all for it. I grew up as

an ecologist and spent my early professional career in forestry and watershed and wildlife protection—and I know about it. So I don't get stampeded by these purists.

Certainly we've done a horrible job of fouling up our rivers and streams and lakes around the world with raw sewage and industrial waste. You name it we've done it. It's the same with atmosphere. We've fouled it up with industrial smog and automotive smog—and we can correct these things and we must.

But when it comes to chemical fertilisers then we must use them—with reasonable care. I'm sure there are a few people who've been killed, but we kill 50,000 or 60,000 people every year with the automobile in the USA alone but it's something we don't discontinue using.

So when people start talking in this idealistic sort of philosophical way—well, I'm not very impressed.

INTERNATIONALIST: Apart from pesticides and fertilisers what are the other key elements in doubling or trebling the yield from a certain patch of land?

BORLAUG: The basic problem is the old worn-out soils of the world. The level of plant nutrient and soil fertility is low. So you've got to find out how to restore fertility—and at the same time you're developing the new seeds.

But there is no magic seed, no miracle strains. There are only some that are highly efficient when properly grown.

There are many facets that have to be put

into harmony in order to make this new technology work.

But if you start changing one of these facets you've got to be prepared to change all of them.

If you change the fertility level then you've got to have an improved variety of seed to utilise this new level of fertility. But also you must have built-in disease resistance, genetically incorporated, or you may lose your investment in seeds and fertiliser.

Or you can end up fertilising weeds and harvesting a bumper-crop of weeds instead of grain. And almost always there'll be a series of insect problems that can be destructive unless you learn to control them. The stem of the plants is now dense and thick and it keeps the moisture and protects the insects from their natural enemies and from being dried out in the sun.

There's no simple answer. You move one piece and you affect fifteen others.

INTERNATIONALIST: You've obviously been successful in balancing the agricultural factors involved, but if the whole effort is to be successful then there are lots of economic and social factors which also need to be brought into line?

BORLAUG: Yes, you've got to work out with government officials the economic factors, especially those which have to do with making it possible for the small farmer to change his traditional ways. For example, you have to establish the reasonable price level for his grain and make sure that this price is maintained at time of harvest—otherwise, well the bottom will

Different wheat strains under observation at the Rockefeller Foundation H.Q. in New Delhi



drop out of the market and he'll be ruined. He'll never invest in change again.

Secondly, you have to make sure that these new inputs like grain and fertilisers are available at the right time, in the right quantity, at the right price—so that if the farmer applies the technology he can make a good income by selling his grain at a reasonable profit.

And the small farmer has to be able to get credit to buy his fertiliser and pesticides etc. Unless you can manipulate all of these factors, and get the governments concerned to commit themselves to it, then nothing changes. The science and technology that you've developed is wasted.

But in addition to all this, there's a third set of factors—the psychological factors that affect the small traditional farmer.

The small peasant farmer throughout the world is always being accused of being an ultra-conservative traditionalist who will never change the methods he and his fathers and grandfathers have used for thousands of years. But the small farmer has been maligned; because we've shown time and time again that if you can demonstrate this new package, in harmony with all the economic factors I've talked about, on the farmer's own property, and show him big yield differences, say 100% or 200%, then he's ready to change. And what's more he's the best extension man you've got because he'll invite all his neighbours in, and he's got some uncles over in another village and some cousins somewhere else and pretty quick, why, you've got 'em all stirred up.

There's no point demonstrating this new technology at some government experimental station because the small farmer's never quite sure what went on and he'll always say: "Well, the government can do that because they've got money from my taxes", and six other reasons, and, although he doesn't generally admit it, he's not sure how much of the change is due to science and technology and how much of it is due to witchcraft. But when you pull off this same demonstration on his own land and he sees it and participates in it, and if you show big differences, then he's ready to change alright.

INTERNATIONALIST: There's also been criticism about the impact on small farmers. The *Financial Times* said in January that the impact is centred around the relatively few well off farmers . . .

BORLAUG: Well I disagree. I've been listening for two days now to people who've studied this out here and they've said it's surprising to them the number of small farmers who have benefited equally as much as the large farmer. Of course it doesn't remove the disparity between the large and the small—but it raises both of them.

Suddenly the small farmer thinks to himself "Not only can I produce a good wheat-crop but now that I know how to use fertiliser, I can get a good paddy crop as well". Some farmers have already learnt how to mani-



Photographs of Dr. Borlaug by courtesy of the Rockefeller Foundation, New Delhi.

pluate three crops. They plant wheat, harvest it quickly, prepare the land again and plant beans, a 60 or 65 day crop, and they harvest that in time to plant rice. It gets complicated but more and more people are learning how to do it, and this is changing everything.

During the last three years, the increase in the wheat crop has increased the gross national product by 1.8 billion dollars above the all-time record harvest in 1965.

That money is in the pockets of the farmers, many of them small farmers, and so they start buying things. He'll buy equipment for sinking a small well; and now he can see the possibilities of producing three to five times his normal harvest, he knows he can't thresh this much grain by treading it with bullocks as was done in biblical days, nor can he winnow it with the wind. When his animals are tied up he can't plough his land for the paddy crop. So what does he do? He goes down to the local blacksmith and says "fix me up a little threshing machine so I can get my bullocks out to plough the fields on time".

Hundreds of thousands of these little threshing machines have been built in the last three or four years—and the farmer starts giving employment, or he says "well, I'm going to get a little tractor out here"—the increase in small tractors has gone on at a tremendous rate. And he buys transistor radios, sewing machines to make clothes, bicycles, etc.

Seventy or eighty per cent of the people are in agriculture. Many of them have been outside the mainstream of economic life—it's just been subsistence farming. But now they've got money.

INTERNATIONALIST: There seems to be a confusion about whether the green revolution is causing unemployment. René Dumont says it is throwing people out of work, Wolf Ladejinsky says its absorbing surplus labour.

BORLAUG: They're all saying it causes unemployment but up to now there's no evidence to back this up—its mostly theory. Unemployment has been rising for a long time, but because of this intensification of cultivation there's more labour being employed at the present time—not only in growing the grain, but in handling it, transporting it, storing it, and many other ways.

The green revolution hasn't created this unemployment thing. You see it's all these negativists. And I'm so damn sick and tired of negativists in the world. What do they propose instead of the green revolution?—nothing! It's easy to criticize; it's damn hard to do something constructive, and so all of these wishy-washy people that deal in ideologies and philosophies and empty words that can't feed hungry bellies—I don't have much sympathy for them.

This criticism is not a very damn pleasant thing to be dealing with when you're trying to provoke constructive change. When you spend your life in it you soon realise that you've got to develop a skin as thick as that of a rhinoceros, and turn off your hearing so you don't hear all of these damn criti-

cisms. Because you've got to live with it and if you lose your equanimity you lose your effectiveness. You get lots of criticism in the beginning. Rumours got around that these dwarf wheats were going to produce less straw and so all the bullocks and cows were going to starve. Then they said it was sterilising the cows and the women—both. God, if this could just have been true we would have really deserved the Peace Prize and perhaps all the other prizes in the Nobel Committee—but unfortunately it never happened!

INTERNATIONALIST: The main criticisms have centred around the social and economic consequences of the green revolution. Have there been unanticipated problems and consequences of the programme—what about support facilities—warehousing and transport, marketing and distribution problems, for example?

BORLAUG: There are many problems which have been created by this so called green revolution. Whenever you provoke change (and change we must or we'll perish just like the dinosaurs) you've got to evolve with it and adapt to a changing situation which you don't always see in advance.

First of all we had a huge warehousing problem, and it's still there. But the government of India has done a marvellous job really in catching up. When you think what the situation was like after the first big harvest.

At that time no-one believed that you could pull off a big harvest. We talked till we were blue in the face for two years before finally telling them to get ready for 16½ million metric tons—20% more than before. No-one would believe you. I went through the same squeeze in West Pakistan and I kept screaming my head off and they kept saying 'look, let's be realistic about this, we've seen lots of other big foreign advisers with big names come in here and tell us to build warehouses and there was no grain forthcoming. You're telling us the same thing'.

But, needless to say, when all at once there were millions of tons of grain dumped out under the open sky and the clouds were building up and it started to rain and they lost some of it—the press got onto them and just raised cane with them, and then they had to close down schools and put some of the grain temporarily into schools and all sorts of odd places from sports stadiums to railroad stations. Then we got action.

INTERNATIONALIST: It's a common point that a "green revolution" won't make a fundamental difference to the quality of life in a developing country unless there's an equivalent "social and political revolution" to take advantage of it. What is your opinion of the political and social scene here in India where you are now working? What political change is needed to enhance the work of the scientists?

BORLAUG: I have great faith in the Indian people to preserve what they have demonstrated so beautifully in the democratic

elections of the last few weeks. I have faith that they will impose more equitable distribution of these benefits from the green revolution. Firstly they will probably be in a position to implement now the Land Ceilings Act that was passed in 1947 but which has never been implemented in the spirit of the law because of the pressures of the very privileged. I think this is coming to an end. I think it will be implemented now. Secondly, I think that new taxation will come into being—an income tax that will distribute wealth to the low income people. I really believe that this will happen.

Of course we've still got to face up to this horrible population monster that stares at us from about 10 different angles. My greatest fear, not only here but in the world in general, is growing unemployment. The UN says there is 20% unemployment in developing countries amongst males of working age. If this is true, then add to it the vast number of women and girls that should be working and who would like to work if there were jobs—and this 20% is growing.

INTERNATIONALIST: If you could manipulate the economic and governmental factors like you can balance the scientific aspects, what steps would you take to make the green revolution more successful?

BORLAUG: Credit. More credit for the small farmer—and then more equitable distribution of land. But credit is the main thing—so that the little guy can participate more fully.

INTERNATIONALIST: You've been working on this project for 27 years in different countries around the world. Throughout those years of preparation did you have a 'vision' of the impact that your work might have?

BORLAUG: In Mexico, where it all began, it was a long hard fight because we were learning how to put all this package together. And you don't realise how much you've learnt because it's been gradual and taken a long time.

When we moved in here I had the feeling that it might just be a transplant of pretty big sociological and economic magnitude. I also felt that it just might, if we played things right, be pulled off rather fast.

But it's been so much faster than ever I'd hoped for. And the key to all this is the Indian scientists. In Mexico there were no trained scientists—three or four worth the name. But here in India there's a vast core of trained scientists.

When we started here they weren't focusing on the prime problems, they were nibbling around the edge of unimportant things and chasing academic butterflies, quite often. But the truth was they were well-qualified scientists. The trouble was that they were all minding their own knitting—the plant geneticist didn't talk to the agronomist or the soil scientist didn't talk to the plant pathologist. They weren't working as a team.

We came in and got these scientists together, just like a football team with a team spirit and the will to win, and we started filling in

the blanks between the disciplines. We used a lot of our scientific know-how out of Mexico of course, and we checked it out on hundreds of thousands of farms. We brought in seed first from Mexico—three or four hundred kilos of our best—checked them for adaptation, found them good, re-checked them on location and then we brought in 250 tons of seed and started growing them on hundreds of farms in demonstrations of how to put the package together. Then in 1967 the Indian Minister of Food and Agriculture played it the whole way—18,000 tons—a shipload full of seed. And he committed the government to the fertiliser that was needed and the credit facilities to go with it and the price structure—the whole thing.

INTERNATIONALIST: Twenty-seven year's work may have brought criticism but it's brought its share of acclaim too; were you surprised to get the Nobel Peace Prize?

BORLAUG: This is something I never really had any hopes of and to me it's just something I leave to one side. This battle goes on.

The criticism doesn't hurt me. I don't care a damn: but I think it's unfair. It's really accusing the green revolution of not being able to solve all the ills of the world from the time of Adam and Eve up to present day—both social and economic ills. And what the hell do you expect? But this is the kind of faulty thinking that's being dished out around the world by purists. I'd like to put some of these theorists who write books out in the front and see what they'd do. But I wouldn't be very hopeful about them!

INTERNATIONALIST: Has there been an increase in the number of scientists interested in the problems of world poverty and social issues as a result of your work and the Nobel Peace Prize?

BORLAUG: There certainly has in these developing countries. Yes, there's a real interest now. The main problem holding them back is the lack of trained people—not only people who are well trained but people with motivation and dedication to social service.

I wouldn't give a nickel for the best scientist in the world, no matter how brilliant, if he doesn't have an inbuilt motivation and dedication to the cause of helping improve the lot of his own people.

I'm talking now about people who are going to work on my food team. I don't want these guys who are brilliant and who are there for their own personal advancement and egoism. They'll never be team players. They'll disrupt rather than help.

I'm very hopeful in having this Nobel Peace Prize come to agriculture, because it is to agriculture as far as I'm concerned. I just happened to be picked out as one guy that symbolised all this, and the Peace Prize is really to hundreds and probably thousands of scientists and government officials in many different countries—and millions of farmers who had the courage to

pick up this new technology, to put in the work, and struggle to improve their lives a little bit—and I feel that it was to all these people that the Nobel Committee spoke when they chose one person to symbolise all this.

INTERNATIONALIST: What are the problems you are working on now in the experimental field? Are there any new breakthroughs on the horizon?

BORLAUG: Well, the question of a balanced diet is still a major problem. Most of the world is so poor that it can't begin to think about eating meat or milk or poultry products in adequate quantities to provide a good balanced diet—they're too expensive. So we've got to think in terms of cereals. But all cereals have one basic defect—they're too low in protein and mostly the proteins are not balanced.

Brain growth in the first two years of a child's life is at its very rapidest peak, and if there's protein malnutrition, well then those who do survive have brain damage.

But now it looks as though we can improve the nutritional value of cereals by genetic engineering of maize and barley.

Just to illustrate the point—one of these new maize things, one of the new OPAQUE 2 derivatives, for example, was a genetic curiosity for a long time until some young graduate student analysed it for amino acids—it had twice the amount! And when they fed this kind of thing to rats they grew at twice the rate. And when it was given to young piglets right after weaning, the same thing happened! And when children who were in an advanced state of kwashiorkor or protein malnutrition were fed with gruel made from OPAQUE 2 Maize, they recovered spectacularly in seven or eight weeks.

With the corrections that have to be made to make it fully acceptable, it will probably be two to three years before this strain is available.

INTERNATIONALIST: What is the most satisfying part of your work now that the whole thing has got off the ground?

BORLAUG: My greatest satisfaction is to see teams of young scientists working out here. They're mean; mean in the sense that they'll never give up. The senior scientist is almost always the ultra-conservative who destroys these groups of young men if they start trying to do things in different ways. I try to protect them from this overpopulated horribly-frustrated and competitive bureaucracy.

INTERNATIONALIST: Do you find the young educated scientists unwilling to involve themselves in development problems of rural areas, unwilling to get their hands dirty?

BORLAUG: This is common in developing countries, but when the F.A.O. started sending us young scientists, we gave 'em plenty of mud and dust and sweat and good hard physical work to make their science

functional. In the last nine years we've had 160 young scientists with us getting this kind of treatment.

INTERNATIONALIST: How did you first get involved in development and agriculture yourself?

BORLAUG: Well, I think it was part of me from the very beginning. I grew up on a very small farm in a rural community. My parents were very humble farmers and I went to a one-roomed school for eight years, and I finished high school in the worst years of the depression. Then I stayed home for a year to run this little farm which wasn't really big enough for Dad and I to work on.

So I worked in the fields from the time I was a boy. I was always curious about how things grew and why they were like they were, what made them grow this way or that way. Of course on this little farm we didn't know anything about chemical fertilisers.

I went to university and worked my way through during the depression. I started my education with about £25 and struggled through by doing all kinds of jobs, laying tables and looking after vet's laboratories, and all sorts of other jobs.

INTERNATIONALIST: What are the new ways, today, for scientists to get to grips with the development problem?

There are all sorts of opportunities for making a contribution—in every field. We just need to think big. I was talking to some students today and I said to them "You have a reason to be impatient at the miserable world we've got". But they must be impatient in a constructive sort of way—to save the good parts of our civilisation. We must recognise that a vast sector of our civilisation is living better than ever before and we must build on this. We must correct the defects.

People who want to help development have lots of opportunities. They should read widely in all different disciplines. They may like teaching, agriculture, medicine—helping in many many different ways. It's a question of finding something that interests them. Emotion is no good if you have nothing to give. I've been trying to tell students not to drop-out in disgust. Let's work to save the good and improve the bad in our civilisation. There are so many who drop out and think they don't owe anything to society. But they do. They eat every day and that food was produced by the sweat of someone's brow. It's just that simple. I just can't buy this business that they don't owe anything to anybody. They're just social parasites when they do this. To destroy is easy—to build is damn hard, and that's why I've no sympathy with this negative philosophy and these 'dropouts'—none whatsoever. **Internationalist**

V.C.O.A.D. are shortly to publish an in-depth study of the green revolution by Ingrid Palmer. Copies will be available from V.C.O.A.D., 69 Victoria St., London, S.W.1