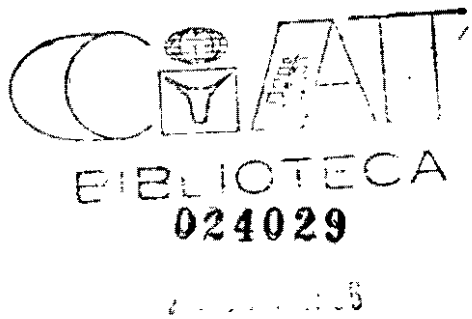

PROCEEDINGS OF A WORKSHOP ON REGIONAL PLANNING OF THE BEAN RESEARCH NETWORK IN SOUTHERN AFRICA

Mangochi, Malawi, 6-8 March, 1991

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PREFACE

This volume reports the proceedings and procedures of a participative planning workshop for the regional bean research and training network in southern Africa, organized by the Southern African Development Community/Centro Internacional de Agricultura Tropical (SADC/CIAT) Regional Programme on Beans in Southern Africa, with financial support from the Canadian International Development Agency (CIDA).

The SADC/CIAT Regional Bean Programme is the bean component of the Grain Legume Improvement Programme of the Centre for Cooperation in Agricultural Research and Training (SACCAR), and is part of a network of interdependent regional projects managed by CIAT in Africa. This workshop was the first of its kind in southern Africa: it provided a precedent for regional collaborative planning of commodity research, and it also provided a fillip to research planning through a similar approach at the national level. At the time of the workshop, following a favourable mid-term evaluation of the project's first phase, the network seemed assured of donor support for a second phase probably of seven years' duration. It was against this setting that the workshop participants developed its plan of action, from which a project proposal was developed. In the event, such support was not forthcoming, necessitating drastic and urgent re-organisation including decentralisation of coordination across the region. These Proceedings should prove a valuable reference both to the newly decentralised coordination of the SADC Bean Network as well as to SACCAR, as the coordinating centre for southern Africa as a whole.

The activities of the bean research networks in Africa continue to be supported not only by CIDA but also by the Swiss Development Cooperation and the U.S. Agency for International Development. Further information on regional research activities on the common bean in the SADC region and in Africa generally is available from :

Regional Coordinator, SADC Bean Network, P.O.Box 2704, Arusha, Tanzania.

Germplasm Coordinator, SADC Bean Network, Chitedze Research Station, P.O. Box 158, Lilongwe, Malawi.

Coordinateur Régional, Réseau pour l'Amélioration du Haricot (*Phaseolae*) dans la région de l'Afrique Centrale (RESAPAC), c/o P.O. Box 2704, Arusha, Tanzania.

Coordinator, Eastern Africa Bean Research Network, P.O.Box 6247, Kampala, Uganda.

Pan-Africa Coordinator, CIAT, P.O. Box 23294, Dar es Salaam, Tanzania.

PUBLICATIONS OF THE NETWORK ON BEAN RESEARCH IN AFRICA

Workshop Series

No. 1. Bean Fly Workshop, Arusha, Tanzania, 16-20 November 1986.

No. 2. Bean Research in Eastern Africa, Mukono, Uganda, 22-25 June 1986.

No. 3. Soil Fertility Research for Bean Cropping Systems in Africa, Addis Ababa, Ethiopia, 5-9 September 1988.

No. 4. Bean Varietal Improvement in Africa, Maseru, Lesotho, 30 January-2 February 1989.

No. 5. Troisieme Seminaire Regional sur L'Amelioration du Haricot dans la Region des Grands Lacs, Kigali, Rwanda, 18-21 Novembre 1987.

No. 6. First SADCC Regional Bean Research Workshop, Mbabane, Swaziland, 4-7 October 1989.

No. 7. Second Workshop on Bean Research in Eastern Africa, Nairobi, 5-8 March 1990.

No. 8. Atelier sur la Fixation Biologique d'Azote du Haricot en Afrique, Rubona, Rwanda, 27-29 October 1988.

No. 9. Quatrieme Seminaire Regional sur L'Amelioration du Haricot dans la Region des Grands Lacs, Bukavu, Zaire, 21-25 Novembre 1988.

No. 10. National Research Planning for Bean Production in Uganda, Kampala, Uganda, 28 January-1 February 1991.

No. 11. First Meeting of the Pan-African Working Group on Bean Entomology, Nairobi, Kenya, 6-9 August, 1989.

No. 12. African Bean Research Workshop, Morogoro, Tanzania, 17-22 September, 1990.

No. 13. Virus Diseases of Beans and Cowpea in Africa, Kampala, Uganda, January 17-21, 1990

No. 14. First Meeting of the SADCC/CIAT Working Group on Drought in Beans, Harare, Zimbabwe, May 9-11, 1988.

No. 15. First Pan-African Working Grop Meeting on Anthracnose of Beans, Ambo, Ethiopia, February 17-23, 1991.

No. 16. Cinquieme Seminaire Regional sur l'Amelioration du Haricot dans la Region des Grands Lacs, Bujumbura, Burundi, 13-18 Novembre, 1989.

No. 17. Sixieme Seminaire Regional sur l'Amelioration du Haricot dans la Region des Grands lacs, 21-25 Janvier 1991.

No. 18. Conference sur le Lancement des Varietes, la Production et la Distribution de Semaines de Haricot dans la Region des Grands Lacs, Goma, Zaire, 2-4 Novembre 1989.

No. 19. Recommendations of Working Groups on Cropping Systems and Soil Fertility Research for Bean Production Systems, Nairobi, Kenya, 12-14 February 1990.

No. 20. First African Bean Pathology Workshop, Kigali, Rwanda, 14-16 November, 1987.

No. 21. Soil Fertility Research for Maize and Bean Production Systems of the Eastern Africa Highlands - Proceedings of a Working Group Meeting, Thika, Kenya, 1-4 September 1992.

No. 22. Atelier sur les Strategies de Selection Varietale dans la Region des Grands Lacs, Kigali, Rwanda, 17-20 Janvier 1991.

No. 23. Pan-African Pathology Working Group Meeting, Thika, Kenya, 26-30 May 1992.

No. 24. Bean Research Planning in Tanzania: Uyole Research Centre, 18-24 May 1992.

No. 25. Second Meeting of the Pan-African Working Group on Bean Entomology, Harare, 19-22 September 1993.

No. 26. Bean Improvement for Low Fertility Soils in Africa: Proceedings of a Working Group Meeting, Kampala, Uganda, 23-26 May 1994.

No. 27. Third SADC/CIAT Bean Research Workshop, Mbabane, Swaziland, 5-7 October 1992.

No. 28. Third Multidisciplinary Workshop on Bean Research in Eastern Africa, Thika, Kenya, 19-22 April 1993.

No. 29. SADC Working Group Meeting of Bean Breeders, Lilongwe, Malawi, 26-29 September 1994.

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No. 1. D. J. Allen, M. Dessert, P. Trutmann and J. Voss. Common beans in Africa and their constraints. P.9-31 in: H. F. Schwartz and M. A. Pastor-Corrales (eds.), Bean Production Problems in the Tropics, 2nd Ed. CIAT, Cali, Colombia.

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C. S. Wortmann and T. Sengooba. 1993. The Banana-Bean Intercropping System - Bean Genotype x Cropping System Interactions. Field Crops Research 31: 19-25.

No. 5. C. S. Wortmann. 1993. Contribution of Bean Morphological Characteristics to Weed Suppression. Agron. J. 85(4): 840-843.

No. 6. L. Sperling and M. E. Loevinsohn. 1993. The Dynamics of Adoption: Distribution and Mortality of Bean Varieties among Small Farmers in Rwanda. Agric. Systems 41: 441-453.

No. 7. M. S. Nahdy. 1994. Bean sieving, a possible control measure for the dried bean beetles, *Acanthoscelides obtectus* (Say)(Coleroptera: Bruchidae). J. Stored Prod. Res. 30 (1): 65-69; and
An additional character for sexing the adults of the dried bean beetle *Acanthoscelides obtectus* (Say)(Coleroptera: Bruchidae). J. Stored Prod. Res. 30 (1): 61-63.

No. 8. Wortmann, C.S., M. Isabirye and S. Musa. 1994. *Crotalaria ochroleuca* as a green manure crop in Uganda. African Crop Science J. 2(1):55-61.

No. 9. L. Sperling, M. E. Loevinsohn and B. Ntabomvura. 1993. Rethinking the Farmer's Role in Plant Breeding: Local Bean Experts and On-station Selection in Rwanda. Expl. Agric. 29: 509-519.

No. 10. K. E. Giller, F. Amijee, S. J. Brodrick, S. P. McGrath, C. Mushi, O. T. Edje and J. B. Smithson. 1992. Toxic concentrations of iron and manganese in leaves of *Phaseolus vulgaris* L. growing on freely-drained soils of pH 6.5 in Northern Tanzania. Communications in Soil Science and Plant Analysis, 23 (15&16), 1663-1669.

CONTENTS

INTRODUCTION

Objective : The purpose of the planning workshop was to provide a forum for discussion, in a fully participative and informal manner, whereby a framework for further development of the regional bean research and training network could be formulated. This laid the basis for planning the second phase of the SADC/CIAT Bean Project for Southern Africa.

Methodology : The workshop relied upon two fundamental tenets : that participation should be sufficiently diverse, to ensure that treatment of the topics under review remained both balanced and reasonably authoritative; and that participation should remain sufficiently small, to encourage an informal, discussive atmosphere. A logical framework, grounded in part upon the concepts embraced by "Project Planning by Objectives" (PPO of the German Technical Cooperation, see Scheidegger and Buruchara, 1992, CIAT African Workshop Series No. 23) and in part on the structure used in Tripp and Wooley, 1989 (in: The Planning Stage of On-farm Research : identifying Factors for Experimentation, CIMMYT/CIAT), employed the following six steps :

problem identification;
ranking of problems in order of priority;
identification of their causes;
analysis of inter-relationships among problems and causes;
identification of solutions;
and an evaluation of those solutions.

Full use was made of flip-charts to visualize ideas expressed by participants during the 'brain-storming' sessions that took part in working groups that were interspersed by a series of plenary sessions. Participants (Appendix 1) were drawn as far as possible from each member country of the network, supplemented by specific national scientists to plug perceived gaps in scientific disciplines, as well as by representatives from extension and the research-extension interface. Invitees from external agencies (e.g. CIDA, as donor; CIAT, as executing agency) were present only as facilitors and resource persons, not as full participants in identifying or setting priorities among constraints nor in choosing strategies for their resolution.

PROBLEM IDENTIFICATION

A 'problem' was taken to mean a priority constraint to increased productivity of beans at the small scale farm level in southern Africa. National Coordinators from Angola, Malawi, Mozambique, Swaziland, Tanzania and Zambia presented lists of perceived constraints on a scale of 1-5 (Table 1).

A total of 44 constraints were identified, and an additional two were added later by the National Coordinator of Zimbabwe. These are shown in Table 2.

Table 1. Scoring scale used in setting priorities among constraints to bean production.

Scale	Criteria
1	**Very important** - Affects most farmers; appears in all seasons; causes severe losses.
2	**Important** - Affects many farmers; appears at least once in two seasons; causes severe losses.
3	**Moderately important** - Affects some farmers; appears occasionally; causes moderate losses.
4	**Importance unclear** - Insufficient information on frequency, distribution or severity.
5	**Unimportant**

Table 2. Identification of constraints by country[1]

Constraint	AN	MO	MW	TZ	WD	ZA	No. of countries	Mean for region	ZW[2]
Lack of seed	1	1	1	4	1	1	6	1.5	1
Lack of inputs	2	1					2	2.3	
Soil infertility	4	1		4	1		4	3.3	
Anthracnose	1		1	3		2	4	2.8	2
Angular leaf spot (ALS)	4	3	1	3	3	3	6	2.8	2
Rust	4		3	3	1	4	5	3.3	3
White mould				3			1	4.7	
Ascochyta blight	4	1		4		4	4	4.5	
Insect pests	4	1					2	4.8	
Irregular rainfall (drought)	2	2	3			3	4	3.0	1
Soil acidity	4		2		1	2	4	3.2	1
Pricing policy	3		1	5			3	4.0	
Lack of improved cultivars	1	1	1		1	2	5	1.8	1
Insecurity		1					1	4.3	
Lack of infrastructure		1					1	4.3	
Halo blight			3	4			2	4.5	2
Web blight			3	4			2	4.5	
Common bacterial blight (CBB)			2	3	3	3	4	3.5	1

Constraint	AN	MO	MW	TZ	WD	ZA	No. of countries	Mean for region	ZW[2]
Bean beetle (*Ootheca*)			2	4	2	2	4	3.3	
Bruchids			1	3	2		3	3.5	1
Aphids			3			2	2	4.3	3
Phosphorus deficiency			1				1	4.3	1
Sulphur deficiency			2				1	4.5	
Land shortage			1		3		2	4.0	
Water-logging			4				1	4.8	
High/low temp.			4	4			2	4.7	
Shortage of labour			2			2	2	4.0	
Poor consumer acceptability			1	4			2	4.2	
Bean common mosaic (BCMV)				4		1	2	4.2	1
Floury leaf spot (FLS)				3			1	4.7	
Low purchasing power				1	1		2	4.7	
Lack of skills				4			1	4.8	
Low market demand				4			1	4.8	
Pod borers (*Heliothis, Maruca*)					2		1	4.5	3
Low producer acceptability					1		1	4.3	
Low plant population					1		1	4.3	
Bean scab						3	1	4.7	
Ineffective extension	2						1	4.5	
Seed storage		2					1	4.5	
Bean stem maggot		3	2	2		1	4	3.0	1
Rats as pests		3					1	4.7	
Pod sucking bugs		3		3			2	4.3	
Low nodulation		4	1		1		3	3.5	1
No promotion of crop		1					1	4.3	
Red spider mite								-	3
Root knot nematodes								-	2

[1] AN= Angola; MO= Mozambique; MW= Malawi; TZ = Tanzania; WD = Swaziland; ZA = Zambia; ZW = Zimbabwe.

[2] Data from Zimbabwe omitted from analysis.

RANKING THE PROBLEMS

The top 20 factors ('problems') were identified by calculating a regional mean (excluding the Zimbabwean scores), and these are summarized in Table 3. Among these 20 constraints, three are insect pests, five are diseases, and two fall directly in the province of plant breeding; together, these were grouped as biotic constraints. Of the remainder, six are concerned with soils, cropping systems and drought; two relate to technology transfer and two are policy issues.

Table 3. Setting regional priorities among constraints

Identified problem	Mean Score[1]	Rank	Category
Lack of seed	1.5	1	Technol. trans.
Lack of improved cultivars	1.8	2	Biotic (1)
Anthracnose	2.8	3	Biotic (2)
Angular leaf spot (ALS)	2.8	4	Biotic (3)
Bean stem maggot (*Ophiomyia*)	3.0	5	Biotic (4)
Drought	3.0	6	Abiotic (1)
Soil acidity	3.2	7	Abiotic (2)
Soil infertility	3.3	8	Abiotic (3)
Rust	3.3	9	Biotic (5)
Bean beetle (*Ootheca*)	3.3	10	Biotic (6)
Low nodulation	3.5	11	Abiotic (4)
Bruchids	3.5	12	Biotic (7)
Common bacterial blight (CBB)	3.5	13	Biotic (8)
Low purchasing power	3.7	14	Policy
Lack of inputs	3.8	15	Technol. trans.
Pricing policy	4.0	16	Policy
Land shortage	4.0	17	Abiotic (5)
Poor crop management	4.0	18	Abiotic (6)
Poor consumer acceptability	4.2	19	Biotic (9)
Bean common mosaic (BCMV)	4.2	20	Biotic (10)

[1] See Table 2.

IDENTIFICATION OF CAUSES OF THE PROBLEMS IDENTIFIED AND RELATIONS BETWEEN FACTORS

Working groups were convened to analyze the major biotic and abiotic constraints now prioritized. It was found that neither policy nor constraints relating to technology transfer (Table 3) were amenable to such analysis, so that they were treated separately later during the workshop. The 'biotic working group' drafted diagrams (Figures 1-9) to show perceived relationships between factors that contribute to each constraint identified. The working group concerned with abiotic contraints quickly found that 'soil infertility' was so complex (Figure 10) that it was best broken down into its components that were found to embrace also other identified components, such as soil acidity, low nodulation and poor crop management. Other abiotic problems are analyzed in Figures 11-12.

IDENTIFICATION OF POTENTIAL SOLUTIONS AND THEIR EVALUATION

During the course of analyzing relationships between factors in the previous exercise, critical points of leverage which might be potential solutions to each problem were inevitably identified (Figures 13-18). The next step was to evaluate the potential solutions identified, in terms of their expected output, the likelihood of research being successful, the feasibility of conducting that research in terms of the necessary resources and time span, and its expected adoption by and impact upon farmers. Priorities were set by calculating the mean of scores assigned each 'potential solution' for each of the above five parameters, and an assessment of the number of years necessary to overcome the given constraint. These steps and the results are shown in Tables 4-17. At this point, the working groups had summarized their main conclusions so that they could then be harmonized into an integrated set of research priorities, with an appropriate balance being given to biotic and abiotic constraints, and obstacles to effective technology transfer. In a plenary session that followed the 'brain-storming' of the working groups, the rapporteur of the 'biotic group' drew attention to the 10 constraints that had been focused upon. Themes that were found in common among many of the constraints were access to improved germplasm, screening methodology, resistance breeding, investigation of pathogenic variation and species complexes, developing cultural control methods, and pilot seed schemes (Table 18).

RESEARCH IN PROGRESS WITHIN AND OUTSIDE THE SADC REGION, THE IDENTIFICATION OF GAPS, ASSIGNING RESPONSIBILITIES AND HUMAN RESOURCES

The 'biotic group' summarized its findings (Table 19) and drafted recommendations for assignment of research responsibility

for the identified gaps either to National Programmes (NP) or the Regional Programme (RP), or a combination of the two. Estimates of human resources are given as a percentage of time by scientific discipline of national programme staff. It was pointed out in discussion in the plenary session that Table 19 had omitted mention of biotechnology which was likely to have growing significance to the network, to whom results would be available through CIAT.

The 'abiotic group' approached the task somewhat differently, by dividing high priority research topics into those of high feasibility, short-term research, those of expected medium duration, and those necessitating long-term commitment, to be tackled by national agricultural research systems (NARS), by the regional network, or by both (Table 20). It was noted that opportunities for developing ties with other networks, particularly in multiple cropping research, should be explored.

In examining the recommendations together, it was observed that there was a larger increase in new regional collaborative research sub-projects on abiotic constraints than on biotic ones. This was felt a fully justifiable shift, reflecting a growing knowledge, for instance in the identification of 'hot spots' for screening against specific edaphic stresses. It was not a shift away from plant breeding because various abiotic constraints also have potential solutions through breeding.

GERMPLASM ORGANIZATION

A working group was convened to consider the organizational aspects of *Phaseolus* germplasm. It was agreed that priorities for further local collection need to be set, noting the SADC/IBPGR Workshop held in Lusaka in September, 1986 on this subject. Support should be sought from IBPGR and from the SADC Regional Gene Bank (SRGB), and the Regional Programme's continued assistance in the development of medium-term storage would be required. Exchanges of national collections within the region may need assistance from the regional network, especially in funding seed multiplication. The SRGB is likely to be able to facilitate exchanges within the region in future, and regional collections should be shared also with CIAT, so as to facilitate crosses with African landraces when required. The Regional Bean Breeder was seen to have an important role in guiding introductions from outside the region, as well as in the compilation of a regional catalogue of collections held in the SADC region. The group ratified the tentative zonation of eastern and southern Africa as had emanated from the bean breeders workshop in Maseru in January 1989 (CIAT African Workshop Series, No. 4), noting that neither the Central African Zonal Bean Yield Nursery/Trial nor the SAZBYN/SAZBYT had yet been initiated. This was an urgent task of the Malawi-based regional breeder. The AFBYAN was strongly supported, but it was deemed appropriate that consideration be given to criteria for subdivision of entries in future sets,

perhaps on the bases of plant habit or seed size, at least until more was known about ecological adaptation of genotypes.

INSTITUTIONAL STRENGTHENING

The key issues that were identified by a working group on training were :

(i) Training emphasis should reflect current needs
(ii) Achieve a balance between training of technicians and graduate scientists
(iii) Aim also at a balance between scientific disciplines
(iv) The future of workshops
(v) The future of monitoring tours
(vi) Undergraduate (BSc) versus post-graduate (MSc and PhD) degree opportunities, within or outside the region.

The main points that emerged were the following : In view of current needs identified, training emphases should focus on research methods and production and extension, including bean production methods, extension-farmer-researcher linkages, and technology transfer. Various subjects are not commodity specific, so that collaboration with other centres in running training courses on the following should be explored : weed management, statistical packages for agricultural research (e.g. MSTAT), agroclimatology, soil science, economics and laboratory methods.

With respect to balance between technician and graduate courses, it was agreed that the current trend be continued, with graduate training continuing at least until 1995 (Figure 19).

Targeting of training at specific disciplines should be adjusted to initiate training of trainers, first to identify needs, then to formulate its organization, coordination and use of visual aids, directed at the emphases given above.

With regard to workshops, it was felt that future multidisciplinary workshops should include extensionists. Discipline-specific working group meetings should be convened more frequently. Monitoring tours should be redesigned as travelling workshops, each focused on regional sub-projects in progress, and each having a plan and budget, and a report with recommendations and an evaluation.

It was agreed that opportunities at the undergraduate level should be sought, especially for Angola, Lesotho, Mozambique, Namibia and Swaziland, using universities within the region. It was noted that lusophone trainees, in particular, were at a comparative disadvantage, so that not all scholarships should be

tied to local universities. Opportunities for women should continue, and all recipients of academic scholarships should be bonded to return to national grain legume programmes, to curtail wastage.

In Phase II, postgraduate opportunities should emphasize MSc degrees. PhD opportunities should involve field research conducted in the region, and the topic of research should lie within the framework of the network's research agenda.

All academic scholarships should be administered by a Scholarship Committee.

TECHNOLOGY TRANSFER

The working group that considered technology transfer identified 22 key points in regard to a discussion of farmer participation; these were :

(i) Cannot involve all farmers
(ii) The concept of "contact farmers" might prove useful
(iii) What farmer selection criteria should be used ?
(iv) Farmer clubs (e.g. in Malawi) might have value as pressure groups
(v) A system of continuous contact with farmers is needed
(vi) Links with extension indispensable
(vii) Need to embrace a wide range of specialists, in planning, extension and administration
(viii) The earlier technology is taken to farmers the better
(ix) Technology needs to be able to spread immediately among farmers : the concept of the "multiplier effect" is relevant
(x) But adoption depends on the appropriateness of technology
(xi) Farmers need to be convinced personally of the benefit of adopting a given technology
(xii) Researchers must review technology and
(xiii) Researchers must discuss technology with extensionists who will then provide feedback,
(xiv) But extensionists must also take the initiative,
(xv) Noting that budgets limit collaborative activities.
(xvi) Researchers need to understand the farming system and the constraints facing the farmer.
(xvii) Too often plant breeders are concerned with the number of cultivars they release, not their rate of adoption.
(xviii) Useful to explore opportunities for short-term solutions to problems,if shown to be economic
(xix) But consider prices of produce, and
(xx) The degree of commercialization of its production.

(xxi) Strengthening of inter-institutional linkages is vital, including collaboration between a commodity team, the farming systems/adaptive research planning team, extension and non-government organizations.
(xxii) Publications, including extension pamphlets, are important.

The Regional Programme was considered to be able to facilitate more effective technology transfer, firstly through training of both researchers and extensionists, preferably together. Secondly, the Steering Committee, and the regional network in general, was seen to play a key role in information exchange on adoption of technology, in developing methods for collaborative surveys, and in catalyzing pilot seed schemes.

Seed production

Seed production was addressed by the working group first by considering case studies with beans from various SADC countries.

The Malawi case. After 10 years, six bean cultivars were released and seed given to the private seed company to multiply. After a further two years, the company lost interest in beans. Extensionists then identified small-holder farmers who produced their own seed, to develop an "action scheme", first with groundnuts, now being extended to beans. Bean seed is inspected by the seed technology unit before it is sent to key bean producing areas, like the Mzuzu Agricultural Development Division.

The Mozambique case. The national seed company, SEMOC, which is supported by the Swedish Company Swalov and by government, produced bean seed for the first time in 1990, seen as an urgent objective of SEMOC.

The Swaziland case. The national seed multiplication company, initiated by CIDA in 1979 and now supported by FAO, focuses on maize. The company is awaiting the release of new bean cultivars, and short cuts to such releases are being sought.

The Tanzania case. In Tanzania, there are national committees for both seed release and seed production. The latter, in conjunction with the Tanzania Seed Company, identify demand and set production, but it is not an effective system, at least for beans. In 1989, it was agreed that bean farmers, and perhaps other agencies, should take responsibility for production, but it is unclear how to proceed, although pilot seed schemes recently initiated, notably in Lushoto, Tanga Region, show promise. Perhaps this is a role for the Regional Programme and Network.

The Zambia case. CIDA support to the Zambia Seed Company,

tied up with the predominant bean production system, meant that seed became too expensive. The system, which had been modelled on Malawi's, differed only in that the funding involved the seed company too. A dissociation from the seed company is now under consideration.

The Regional Programme's Role. There seem two possible ways:

(i) Review case studies presented at a workshop, focusing on qualitative data, or

(ii) To conduct a more detailed study to collect more quantitative, comparable data, using standardized methods of collecting samples for assessment, then running adoption studies afterwards. Points to be considered would include : the amount and sources of seed; opportunities for regional trade; opportunities for linking into training courses (e.g. on FAO seed schemes).

A question was raised as to how best to address emergency needs of several tons of seed in bulk, of appropriate cultivars, noting that it is usual that aid deliveries are of ill-adapted or unacceptable cultivars. It was recognized that the AFBYAN was potentially useful in guiding varietal choice, but no firm conclusion was reached on how to respond to such a situation, as currently prevails in Mozambique.

SUSTAINABILITY OF THE BEAN NETWORK

This working group considered two fundamental questions :

(i) What should be in place at the end of a seven year Phase II so as to ensure that the bean network can continue?

(ii) What action needs to be taken during Phase II to plan for that?

The main points agreed upon to answer the first question were the following:

(i) The minimum that should remain in place are : the Steering Committee, mechanisms for continued information exchange including workshops, regional exchanges of germplasm including regional nurseries and trials, and collaborative research sub-projects in selected topics.

(ii) Sub-project leaders would be responsible for seeking small grants, coordinated by the Steering Committee, and should assume full responsibility for regional activities

on the topic.

(iii) A network coordinator should remain in place. Options include the recruitment of a NARS scientist on a part-time basis, with or without rotation; a full-time scientist funded through SACCAR; or a Pan African Coordinator, under a broader umbrella (e.g. PTA).

Action to be taken during the next seven years should include the following:

(i) Plan to complete most training for most countries.
(ii) Sensitize governments to the consequences of lost human resources (+ SACCAR)
(iii) Assess all equipment needs now.
(iv) Develop and document successful collaborative research sub-projects, including an economic evaluation of benefits to individual countries.
(v) Develop the role of sub-project leaders, taking primary responsibility for collaboration around the research topic, including regional nurseries, training courses and travelling workshops.
(vi) Plan for an operational review at mid-term during Phase II.
(vii) Sensitize governments to the economic importance of beans through conducting joint studies (NARS/SACCAR/CIAT).
(viii) Draw up national research action plans, to ensure that the limited funds available to NARS are used effectively, catalyzed by the Regional Programme if necessary.
(ix) Ensure that such national plans include emphasis on research-extension liaison, and that governments increase commitment to support operation and maintenance.

CONCLUSION

Following presentations by each of the working groups, the consensus of opinion expressed by delegates was that the workshop had been an excellent exercise, and a truly participative one. It was important to set research priorities and identify gaps, and it is important that the participants had started to look at a future without donors. Sustainability is a major concern, and it is fully appropriate to begin addressing this now. Greater publicity of the regional network seems warranted so as to make policy makers more aware of the potential sustainability of a decentralized model such as a regional network, as well as its increased economic efficiency, through collaborative research. Above all, sustainability seems most likely to be assured if the network pays extra attention to making impact.

Table 4. POTENTIAL SOLUTIONS TO THE LACK OF IMPROVED CULTIVARS (Constraint No. 2)

POTENTIAL SOLUTIONS	EXPECTED OUTPUT	LIKELIHOOD OF SUCCESS (1-3)	FEASIBILITY: RESOURCES (1-3)	FEASIBILITY: TIME (1-3)	FARMER ADOPTION (1-3)	IMPACT (1-3)	PRIORITY RANK[1]	TIMING (YRS)
Human Resource development	Stronger breeding programmes	1	2	3	N/A	1	1.4	7
Germplasm access	Accelerated development of improved cultivars	1	2	3	N/A	1	1.4	7
Strengthen extension : farmer : research linkages	Well targeted cultivars	2	3	3	1	1	2.0	7
Improve seed availability	Better access to seed	2	2	3	1	1	1.8	7
Strengthen breeder-seed producer links	Improved seed quality	1	2	2	N/A	1	1.4	4
Improve seed storage methods	Availability of good quality seed	2	2	3	2	1	2.0	7
Bruchid Control	Decreased losses	2	2	3	1	1	1.8	7

[1] Mean of scores of the five assessment criteria shown in preceding columns.

Table 5. POTENTIAL SOLUTION TO ANTHRACNOSE AND ANGULAR LEAF SPOT (Constraints No.3 and 4).

POTENTIAL SOLUTIONS	EXPECTED OUTPUT	LIKELIHOOD OF SUCCESS (1-3)	FEASIBILITY: RESOURCES (1-3)	FEASIBILITY: TIME (1-3)	FARMER ADOPTION (1-3)	IMPACT (1-3)	PRIORITY RANK	TIMING (YRS)
Access to germplasm	Develop resistant cultivars	1 (1)	2 (2)	2 (3)	1 (1)	1 (1)	1.4 (1.6)	5 (7)
Improve research resources	Improved screening	1 (1)	2 (2)	1 (1)	N/A (N/A)	2 (2)	1.2 (1.2)	3 (3)
Improve research methods	Improved screening	1 (1)	2 (2)	2 (3)	N/A (N/A)	1 (2)	1.2 (1.6)	5 (7)
Integrated disease management	Reduced losses	2 (2)	1 (1)	3 (3)	1 (1)	2 (2)	1.8 (1.8)	7 (7)
Access to clean seed	Reduced losses	2 (2)	1 (1)	1 (1)	1 (1)	2 (2)	1.6 (1.4)	3 (3)
Study pathogenic variation	Improved understanding leading to stabilized resistance	1 (1)	3 (3)	3 (3)	N/A (N/A)	2 (3)	1.8 (2.0)	7 (7)

Table 6. POTENTIAL SOLUTIONS FOR BEAN STEM MAGGOT (Constraint No. 5).

POTENTIAL SOLUTIONS	EXPECTED OUTPUT	LIKELIHOOD OF SUCCESS (1-3)	FEASIBILITY		FARMER ADOPTION (1-3)	IMPACT (1-3)	PRIORITY RANK	TIMING (YRS)
			RESOURCES (1-3)	TIME (1-3)				
Study species complex	Understanding species complex	1	3	3	NA	3	2.0	7
Germplasm evaluation	Resistant cultivars	2	3	2	1	1	2.0	7
Screening methodology	Improved evaluation	2	3	3	1	1	2.0	7
Ameliorate environmental stress	IPM	2	3	3	1	1	2.0	7
Biological control	IPM	3	3	3	1	1	2.6	7
Cultural control	IPM	3	2	3	2	2	2.4	7
Chemical control (seed dressing)	IPM	1	2	1	1	1	1.2	3

Table 7. POTENTIAL SOLUTIONS FOR DROUGHT (Constraint No. 6).

POTENTIAL SOLUTIONS	EXPECTED OUTPUT	LIKELIHOOD OF SUCCESS (1-3)	FEASIBILITY		FARMER ADOPTION (1-3)	IMPACT (1-3)	PRIORITY RANK	TIMING (YRS)
			RESOURCES (1-3)	TIME (1-3)				
Tolerant cultivars (cvs)	New cultivars	1	2	2	1	1	1.4	6
Ridging	Recommendations	1	2	1	3	1	1.6	4
Minimum tillage	Recommendations	2	2	2	2	1	1.8	5
Tolerant cultivars to pests and diseases	New cultivars for early planting	2	2	1	1	1	1.4	4
Afforestation	Policy	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Agroforestry	Agron. recommendations	2	2	2	3	2	2.2	9
Organic manure	FYM/Green manure, crop residues	2	2	2	2	1	1.8	6

Table 8. POTENTIAL SOLUTIONS FOR SOIL ACIDITY (Constraint No. 7).

POTENTIAL SOLUTIONS	EXPECTED OUTPUT	LIKELIHOOD OF SUCCESS (1-3)	FEASIBILITY		FARMER ADOPTION (1-3)	IMPACT (1-3)	PRIORITY RANK	TIMING (YRS)
			RESOURCES (1-3)	TIME (1-3)				
Liming	Recommendations	2	2	1	3	2	2.0	4
Rock phosphate	Recommendations	2	1	1	2	2	1.6	5
Tolerant cultivars to Low pH	New cultivars	1	1	1	1	2	1.2	4
Toxicities								
Tolerant cultivars to Fe	New cultivars	3	3	3	1	2	2.4	7
Tolerant cultivars to Mn	Tolerant cultivars	2	2	2	1	2	1.8	5
Tolerant cultivars to Al	Tolerant cultivars	2	2	2	1	2	1.8	4

Table 9. POTENTIAL SOLUTIONS FOR SOIL INFERTILITY AND LOW NODULATION (NUTRIENT CONTENT) (Constraints No. 8 and 11).

POTENTIAL SOLUTIONS	EXPECTED OUTPUT	LIKELIHOOD OF SUCCESS (1-3)	FEASIBILITY RESOURCES (1-3)	FEASIBILITY TIME (1-3)	FARMER ADOPTION (1-3)	IMPACT (1-3)	PRIORITY RANK	TIMING (YRS)
Fertilization	Non acidifying inorg fertilizer Recommendations	1	1	1	2	1	1.2	4
Organic manuring	FYM/green manure Recommendations	2	2	2	2	1	1.8	6
Deep-rooted crops + trees	Cropping systems Recommendations	2	2	2	2	1	2.0	10
Biologoical Nitrogen Fixation	Cultivars + strains + inoculation methods	2	2	1	1	2	1.6	5
Agroforestry	Cropping systems Recommendations	2	2	2	2	1	2.0	10
Land and crop husbandary	Agronomic Recommendations for erosion	1	2	2	2	1	1.6	5
Mulching	Agronomic Recommendations	1	2	2	2	1	1.6	5
Cultivars tolerant to low P	New cultivars	2	2	2	1	2	1.8	6

Table 10. POTENTIAL SOLUTIONS FOR RUST (Constraint No. 9).

POTENTIAL SOLUTIONS	EXPECTED OUTPUT	LIKELIHOOD OF SUCCESS (1-3)	FEASIBILITY		FARMER ADOPTION (1-3)	IMPACT (1-3)	PRIORITY RANK	TIMING (YRS)
			RESOURCES (1-3)	TIME (1-3)				
Access to germplasm	Develop resistant cultivars	1	1	1	1	2	1.2	3
Improve research resources	Improved screening	1	1	1	N/A	2	1.0	3
Improve research methods	Improved screening	1	2	2	N/A	2	1.4	5
Integrated disease management	Reduced losses	2	1	3	1	2	1.8	7
Study pathogenic variation	Improved understanding leading to stabilized resistance	1	3	3	N/A	3	2.0	7

Table 11. POTENTIAL SOLUTIONS FOR BEAN BEETLE (*Ootheca*) (Constraint No. 10).

POTENTIAL SOLUTION	EXPECTED OUTPUT	LIKELIHOOD OF RES. SUCCESS	FEASIBILITY		FARMER ADOPT.	IMPACT	PRIORITY RANK	TIMING 1992-99 YEARS
			TIME (1-3)	RESOURCES (1-3)		(1-3)		
Breed for Resistance	Resistant CVs	3	3	3	1	2	2.4	15
Breed for Tolerance	Tolerant CVs	2	2	2	1	2	1.8	7
Indigenous Plant products	Low cost control methods	2	2	1	2	2	1.8	5
Cultural Control	Agronomy Recommendations	2	1	2	3	2	2.0	5

Table 12. POTENTIAL SOLUTIONS FOR BRUCHIDS (Constraint No. 12).

POTENTIAL SOLUTIONS	EXPECTED OUTPUT	LIKELIHOOD OF SUCCESS (1-3)	FEASIBILITY		FARMER ADOPTION (1-3)	IMPACT (1-3)	PRIORITY RANK	TIMING (YRS)
			RESOURCES (1-3)	TIME (1-3)				
Develop resistant/ adaptable cultivars	Resistant cultivars	1	1	2	1	1	1.2	7
Develop appropriate storage facilities	Low cost storage facilities	1	1	1	2	2	1.4	5
Study species	Understand species complex	1	2	2	N/A	2	1.4	7

Table 13. POTENTIAL SOLUTIONS FOR COMMON BACTERIAL BLIGHT (Constraint No. 13).

POTENTIAL SOLUTIONS	EXPECTED OUTPUT	LIKELIHOOD OF SUCCESS (1-3)	FEASIBILITY: RESOURCES (1-3)	FEASIBILITY: TIME (1-3)	FARMER ADOPTION (1-3)	IMPACT (1-3)	PRIORITY RANK	TIMING (YRS)
Breed for resistance	Resistant cultivars	2	2	3	1	1	1.8	7
Develop pilot seed production schemes	Clean seed	2	2	2	1	1	1.6	5
Study nature of pathogenic variation	Understand pathogenic variation	2	2	2	N/A	3	1.8	5

Table 14. POTENTIAL SOLUTIONS FOR LAND SHORTAGE (Constraint No. 17).

POTENTIAL SOLUTIONS	EXPECTED OUTPUT	LIKELI-HOOD OF SUCCESS (1-3)	FEASIBILITY: RESOURCES (1-3)	FEASIBILITY: TIME (1-3)	FARMER ADOPTION (1-3)	IMPACT (1-3)	PRIORITY RANK	TIMING (YRS)
1. Multiple cropping	Agron. recommendations							
Coffee/Tea	for estates	1	1	1	2	1	1.2	4
Bananas	Estate/small farmers	1	1	1	1	2	1.2	3
Sugarcane	Estates	1	1	1	2	2	1.4	4
Rice	Small farmers	2	2	1	2	2	1.8	4
Tobacco	Estates/small farmers	2	2	1	1	2	1.6	4
Maize/sorghum	Small farmers	1	1	1	1	2	1.2	3
Cassava	Small farmers	1	1	1	1	2	1.2	4
2. Agroforestry								
(Taungya) system	Small farmers	1	2	2	2	2	1.8	7
Valley bottoms ("Dimba")	Small farmers	2	3	2	2	1	2.0	5

Table 15. POTENTIAL SOLUTIONS FOR POOR CROP MANAGEMENT (Constraint No. 18).

POTENTIAL SOLUTIONS	EXPECTED OUTPUT	LIKELIHOOD OF SUCCESS (1-3)	FEASIBILITY: RESOURCES (1-3)	FEASIBILITY: TIME (1-3)	FARMER ADOPTION (1-3)	IMPACT (1-3)	PRIORITY RANK	TIMING (YRS)
Research focused on farmers' problems	Adoptable recommendations	1	2	2	1	1	1.4	4
OFR/farmer participation	Quicker acceptability	1	2	2	1	1	1.4	3
Extension - research and farmer linkages	Better and more relevant techn. transference	2	1	2	3	1	1.8	6

Table 16. POTENTIAL SOLUTIONS FOR POOR CONSUMER ACCEPTABILITY (Constraint No. 19).

POTENTIAL SOLUTIONS	EXPECTED OUTPUT	LIKELIHOOD OF SUCCESS (1-3)	FEASIBILITY		FARMER ADOPTION (1-3)	IMPACT (1-3)	PRIORITY RANK	TIMING (YRS)
			RESOURCES (1-3)	TIME (1-3)				
Establish consumer preferences	Better targeted cultivars	1	1	2	1	1	1.2	4
Collect and combine germplasm	Widen diversity	1	2	2	N/A	N/A	1.7	5

Table 17. POTENTIAL SOLUTIONS FOR BCMV (Constraint No. 20).

POTENTIAL SOLUTIONS	EXPECTED OUTPUT	LIKELIHOOD OF SUCCESS (1-3)	FEASIBILITY		FARMER ADOPTION (1-3)	IMPACT (1-3)	PRIORITY RANK	TIMING (YRS)
			RESOURCES (1-3)	TIME (1-3)				
Identify wild hosts	Elimination of wild hosts	3	3	3	2	3	2.8	7
Breed for resistance	Resistant cultivars	1	2	2	1	1	1.4	5
Identify vector control methods	More effective control	3	3	3	2	2	2.6	7
Study strain variation	Understand pathogenic variation.	1	2	2	N/A	2	1.4	5

Table 18. BIOTIC CONSTRAINTS : IDENTIFICATION OF COMMON THEMES AMONG POTENTIAL SOLUTIONS TO INDIVIDUAL CONSTRAINTS[1]

CONSTRAINT (RANK)	ACCESS TO IMPROVED CULTIVARS (2)	ANT (3)	ALS (4)	BSM (5)	RUST (9)	OOTHECA (10)	BRUCHIDS (12)	CBB (13)	CONSUMER ACCEPT-ABILITY (18)	BCMV (20)
IMPROVED G'PLASM ACCESS	1.4	1.4	1.6	2.0	1.2				1.7	
SCREENING METHODOLOGY		1.2	1.2	2.0	1.0					
RESISTANCE BREEDING						2.4	1.2	1.8		1.4
PILOT SEED SCHEMES	1.8	1.6	1.4					1.6		?
DEVELOPING CULTURAL CONTROL METHODS		1.8	1.8	2.4	1.8	2.0		?		2.7
UNDERSTAN-DING PATHOGENIC VARIATION/ SPECIES COMPLEXES		1.6	2.0	2.0	2.0		1.4	1.8		1.4

[1] Priority rank scores (see Tables 4,5,6,10,11,12,13,16 and 17)

Table 19. BIOTIC CONSTRAINTS: IDENTIFICATION OF WORK IN PROGRESS WITHIN AND OUTSIDE THE SADC REGION, GAPS IN RESEARCH, RESPONSIBILITIES AND RESOURCES.

	Regional collaborative research sub-projects	Extra-regional links (Africa)	National programme activities	Academic Scholar-ships	Links outside Africa	Gaps	Assigned Responsibilities	Human Resources (% time/discipline/National Programme)
ANT	- Estab. importance + distribution. - Race prevelance - Resist. Screening - Cult. Control (mixtures)	East Africa sub-project GLR sub-project [PADN]	Tz. res. screen. Za screen (poor method-ology)	-	IBAT: ANT. diff-erentials	Pathogenic variation. Breeding for ANT res: Pilot seed scheme: Screening methods	- Pan African - NP/RP : NP - ZA, MA, TZ, AN : RP --> Nurseries - NP/RP - Sub-project	0.1 Pathologist 0.05 Breeder 0.5 X 10 = 5.0 0.5 X 10 = 0.5 Breeder 0.5 X 10 = 0.5 Agronomist 0.2 X 10 = 2.0 Seeds specialist 0.1 X 2 = 0.2 Pathologist
ALS	- Screening Malawian germ.	GLR sub-project [PADN]	Tz res. screen (TALSN) Za screen	-	BALSIT CRISP/ Bunda ALS. diff-erentials	Pathogenic variation. Pilot seed scheme Breeding for ALS Res. Improv. screening methods Cultural control methods	- NP/RP - NP/RP - NP/RP - Sub-project - NP	0.2 X 10 = 2.0 Pathologists 0.1 X 10 = 1.0 Breeder 0.02 X 10 = 0.2 Agronomist 0.05 X 10 = 0.5 Pathologist
RUST		East Africa sub-project [East Africa Regional Rust Nurs.]	Screening - Tz - Za - Mw Cultivar mixtures - Mw	Ph.D thesis (Ethiopia)	Nebraska [IBRN] Rust diff-erentials	Race mapping Inadequate screening Cultural contol methods	- NP/RP - NP/RP - NP/RP	0.1 X 10 = 1.0 Training pathologist 0.02 X 10 = 0.2 Agronomist
CBB	-	East Africa sub-project [EARCBBN]	Screening	Ph.D thesis (Uganda)	VIB	Breeding for CBB resistance Pilot seed scheme Pathogenic variation unknown	- NP/RP - NP/RP - SADCC sub-project and Pan Africa sub-project	0.1 X 10 = 1.0 Breeder

	Regional collaborative research sub-projects	Extra-regional links (Africa)	National programme activities	Academic Scholar-ships	Links outsides Africa	Gaps	Assigned Responsibilities	Human Resources (% time/discipline/National Programme
BCMV	- Resistance to necrotic strains - Strain ident. - Aphid vector management	Uganda screening	Screening - Za - Zw	Ph.D thesis (Zimbabwe)	Wellesbourne (ODA) [IBCMBRN]	Unsupported & Insufficient & Inadequate screening	- Sub-project - NP/RP	0.2 Virologist - Training
BSM	- Resistance for breeding	East Africa sub-project - resistance mechanisms - identification of res. sources. Screening methodology ABFRN	Screening - Za - Tz - Mw Cultural control - Tz	Ph.D thesis (Ethiopia) M.Sc thesis (Uganda)	AVRDC/CIAT	Biological control Species distribution Cultural control Few resistant sources Low levels of resistance Safe and cheap insecticides.	- NP/ICIPE/IITA - NP - NP - NP/RP - NP/RP - NP	- Academic scholarships
OOTHECA	-	-	-	-	-	Breeding for tolerance Indigenous plant products Cultural control Biological control Biology of species.	- NP/RP - NP - NP - NP/ICIPE/IITA - NP/RP	- Academic scholarships - Academic scholarships
BRUCHIDS	Zw and Tz. Biology, ecology control	East Africa sub-project	- Traditional seed treatment. - Breeding for resistance at SUA.		WISCONSIN/ CIAT	Species complex Breeding for resistance. Screening methods Storage facilities	- NP/RP - NP - NP/RP - NP	
ACCESS TO IMPROVED CULTIVARS	-	AFNYAN Zonal trials	-Germplasm collection Breeding variety on-farm trials Distribution of improved materials	3 Ph.Ds in breeding	VEF IBYAN CIAT Crosses	Human resource develop Germplasm access Extension research linkages Pilot seed schemes Seed storage	NP	
CONSUMER ACCEPTABILITY	-	Ethiopia Great Lakes Farmer participatory research (FPR)	FPR-Tz. WD ARPT-ZA.MW Cooking time		CIAT	Farmer participatory research Access to germplasm Breaking the linkages	- NP/RP (Training) - NP - NP	

Table 20. ABIOTIC CONSTRAINTS : IDENTIFICATION OF HIGH PRIORITY RESEARCH AND ASSIGNMENT OF RESPONSIBILITY TO UNDERTAKE IT.

1. **High priority and high feasibility (short-term research)**

Research topic	Assigned responsibility
Fertilization in existing systems, including nutrient budget.	NARS/Network (ZW)
Cultivars tolerant to low soil pH	Network
Multiple cropping with tea/coffee	NARS
Multiple cropping with banana	NARS
Multiple cropping with wheat/barley	Network
Multiple cropping with cassava	NARS
Multiple cropping with sugar cane	NARS
Workshop on information exchange	
: training course	RP
: surveys and implementation of regional case studies	NARS
Focus on farmer problems	
Farmer participative research	
: training and implementation	NARS
Cultivars tolerant to drought	Network - NARS (continued)
Cultivars resistant to insect pests and diseases, for drought avoidance	

Table 20. (Continued).

2. **High priority medium-term research**

Research topic	Assigned responsibility
Organic manuring (nutrients, drought)	Network - NARS
Biological nitrogen fixation	Network - NARS (continued)
Land and crop husbandry	
Rock phosphate	Network - NARS (Tz)
Cultivars tolerant to low P	Network - NARS (Za, Tz)
Cultivars tolerant to high Mn	Network - NARS (Pan-African)
Cultivars tolerant to high Al	Network - NARS (Za)
Ridging techniques against drought	NARS
Minimum tillage (drought, soil erosion, labour)	
Multiple cropping with rice	NARS - Network (information exchange)
Multiple cropping with tobacco	
Agroforestry with Taungya system	NARS
Extension/Research/Farmer linkage	NARS - Network (case studies for workshop)

3. **High priority long-term research**

Research topic	Assigned responsibility
Deep-rooted crops and trees	Network/ICRAF
Exploiting valley bottoms ("dimbas")	Network/AVRDC

Fig.1 Constraint No. 2 : LACK OF IMPROVED CULTIVARS

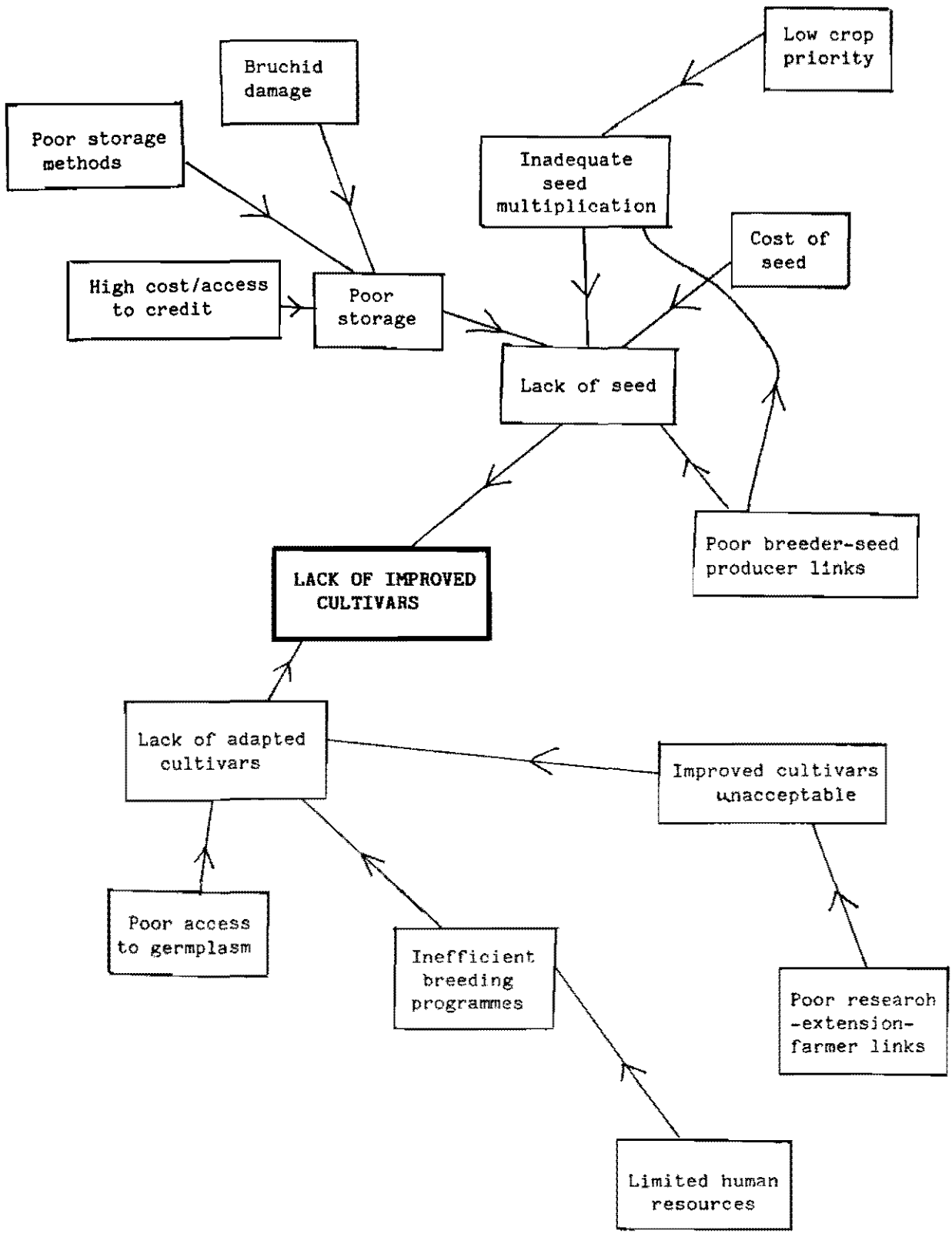
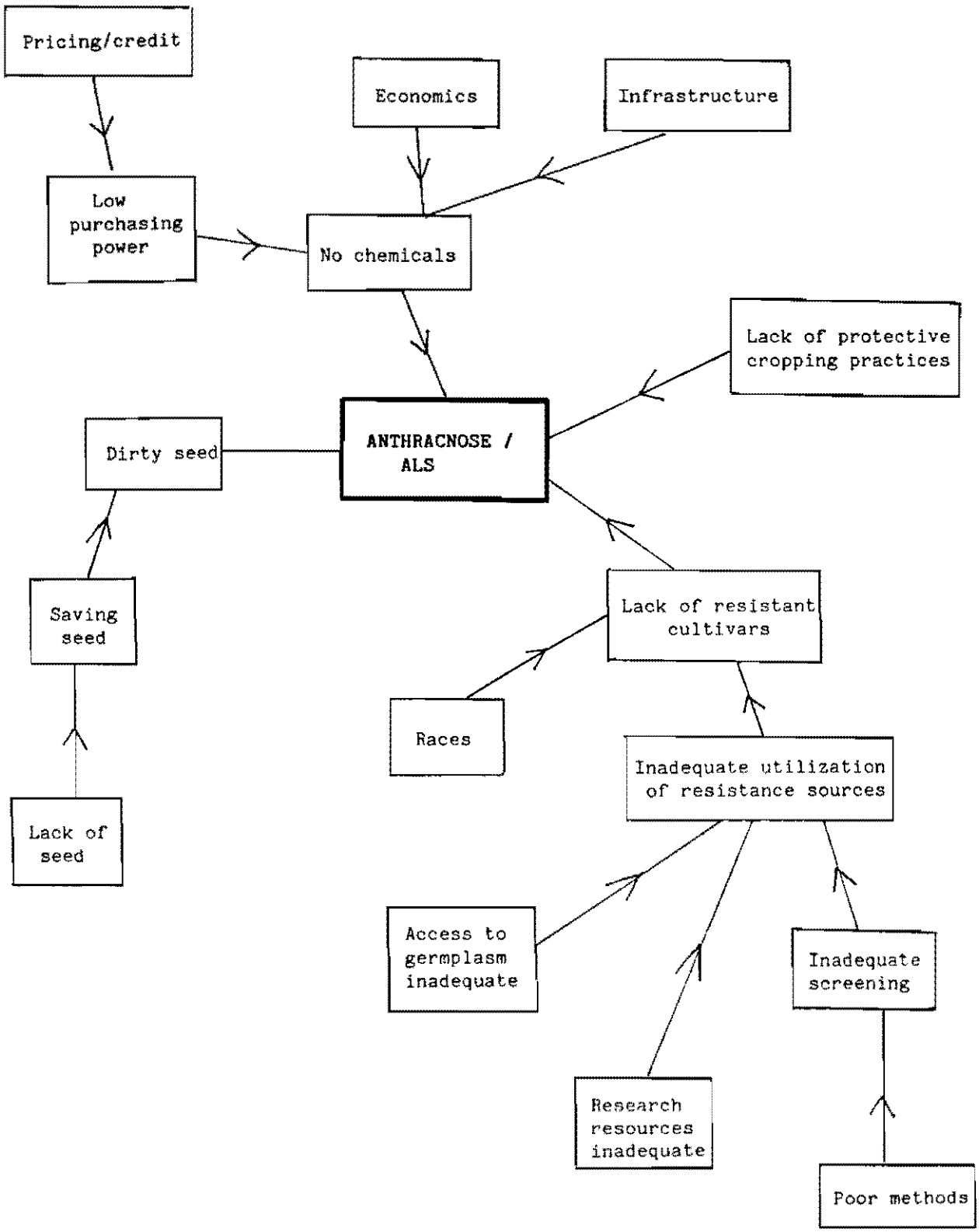


Fig. 2 Constraints Nos. 3 and 4 : ANTHRACNOSE AND ANGULAR LEAF SPOT



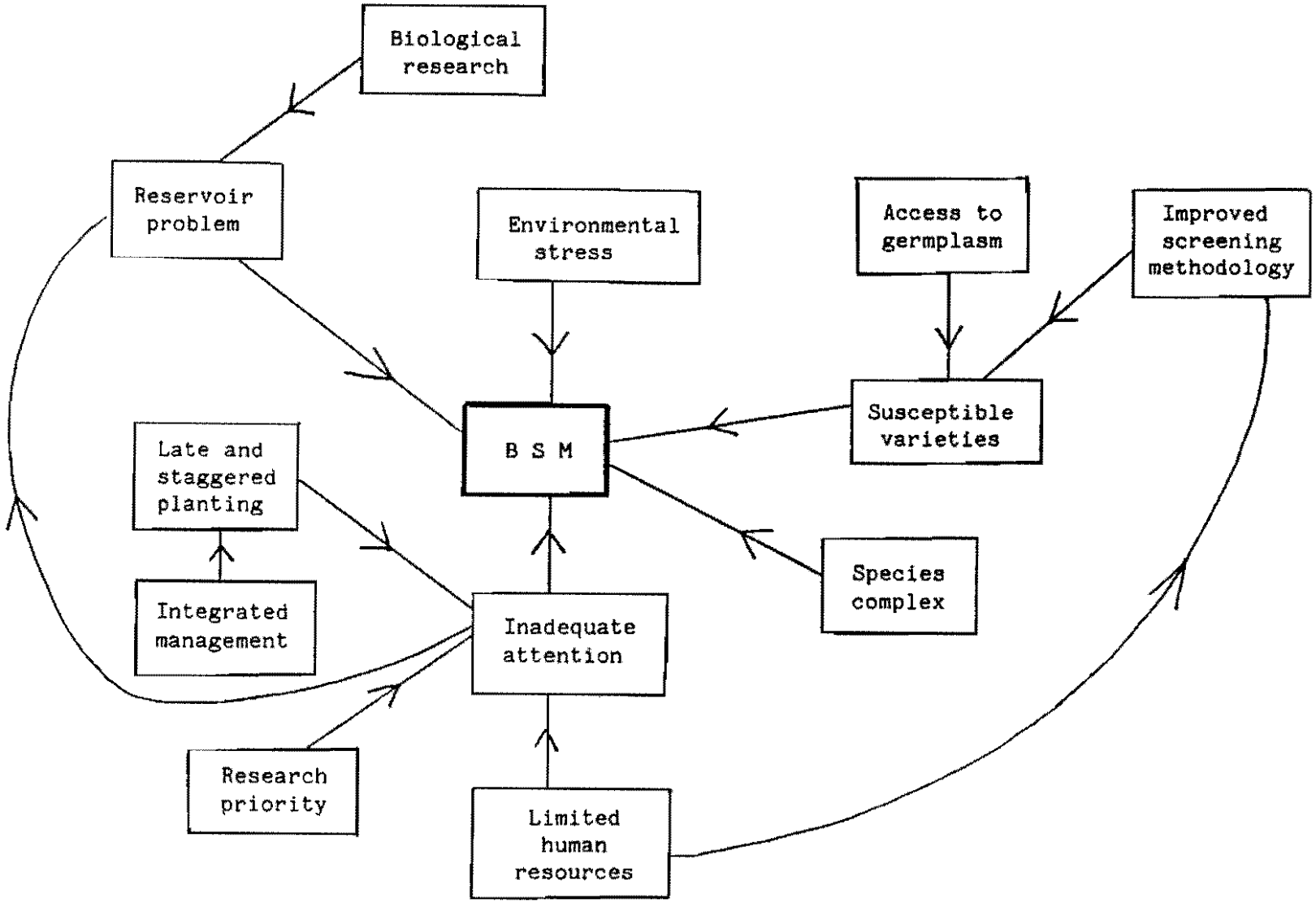


Fig. 3 Constraint No. 5 : BEAN STEM MAGGOT

Fig. 4 Constraint No. 9 : RUST

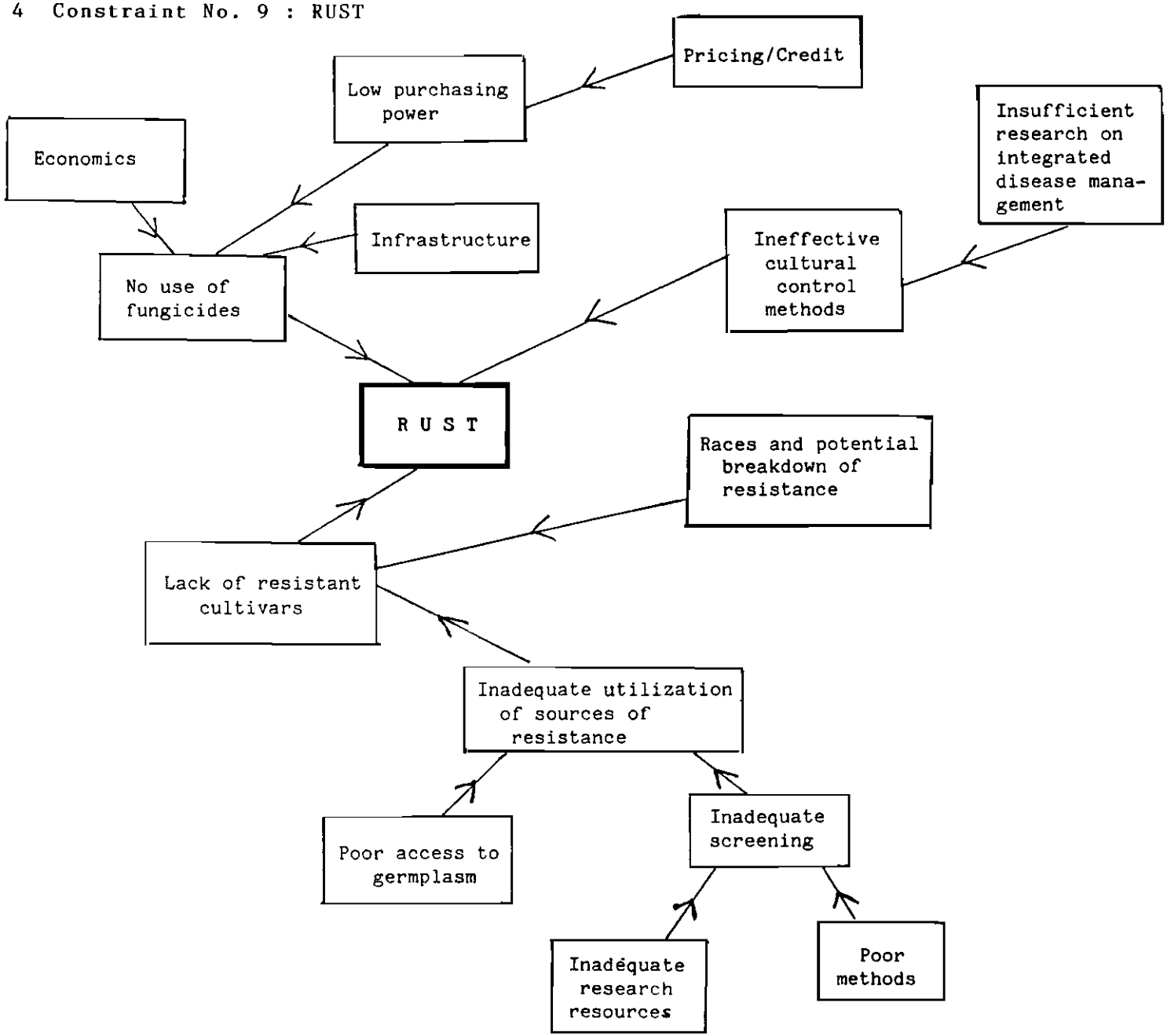


Fig. 5 Constraint No. 10 : BEAN BEETLE (Ootheca spp.)

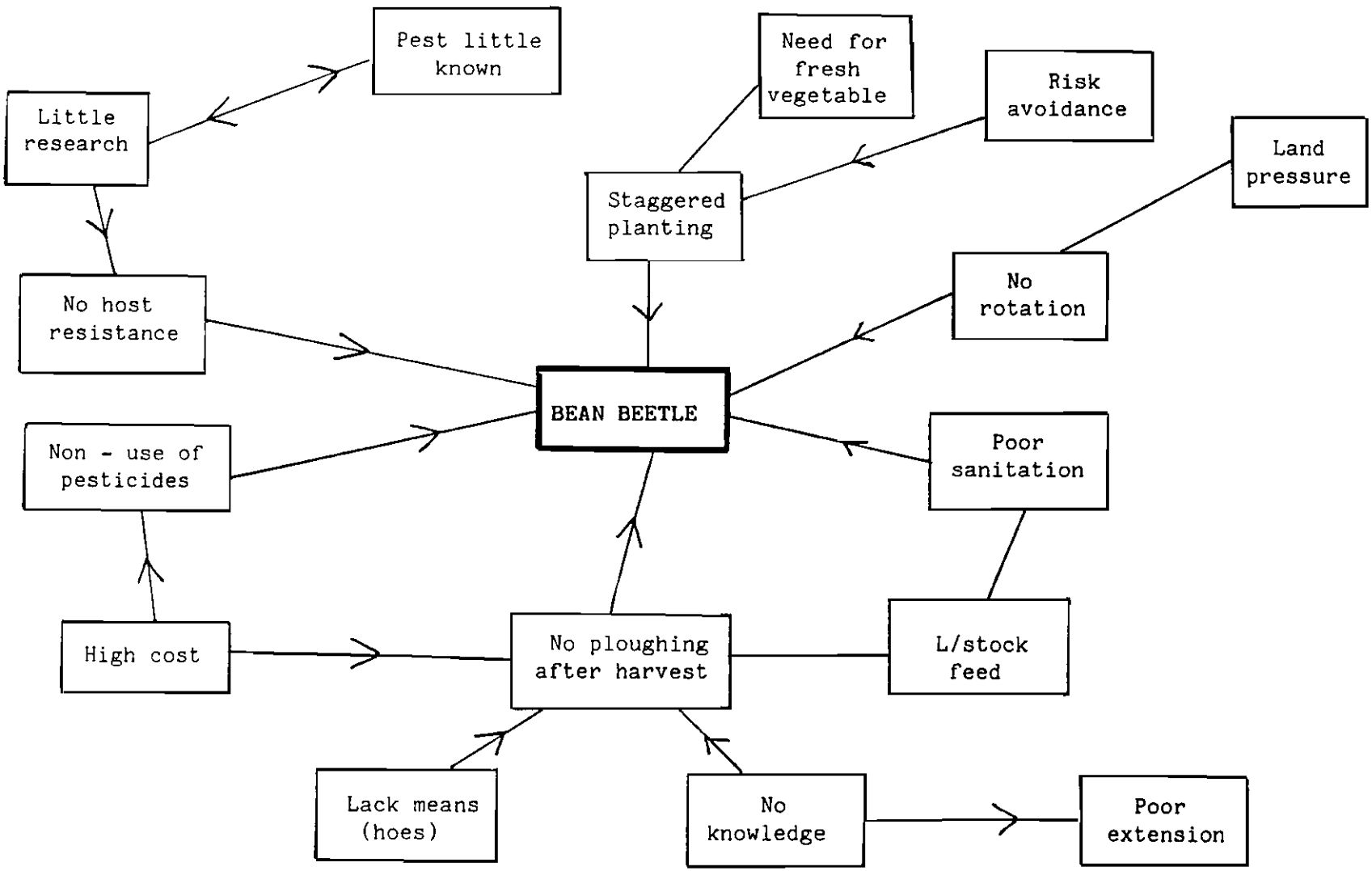


Fig. 6 Constraint No. 12 : BRUCHIDS

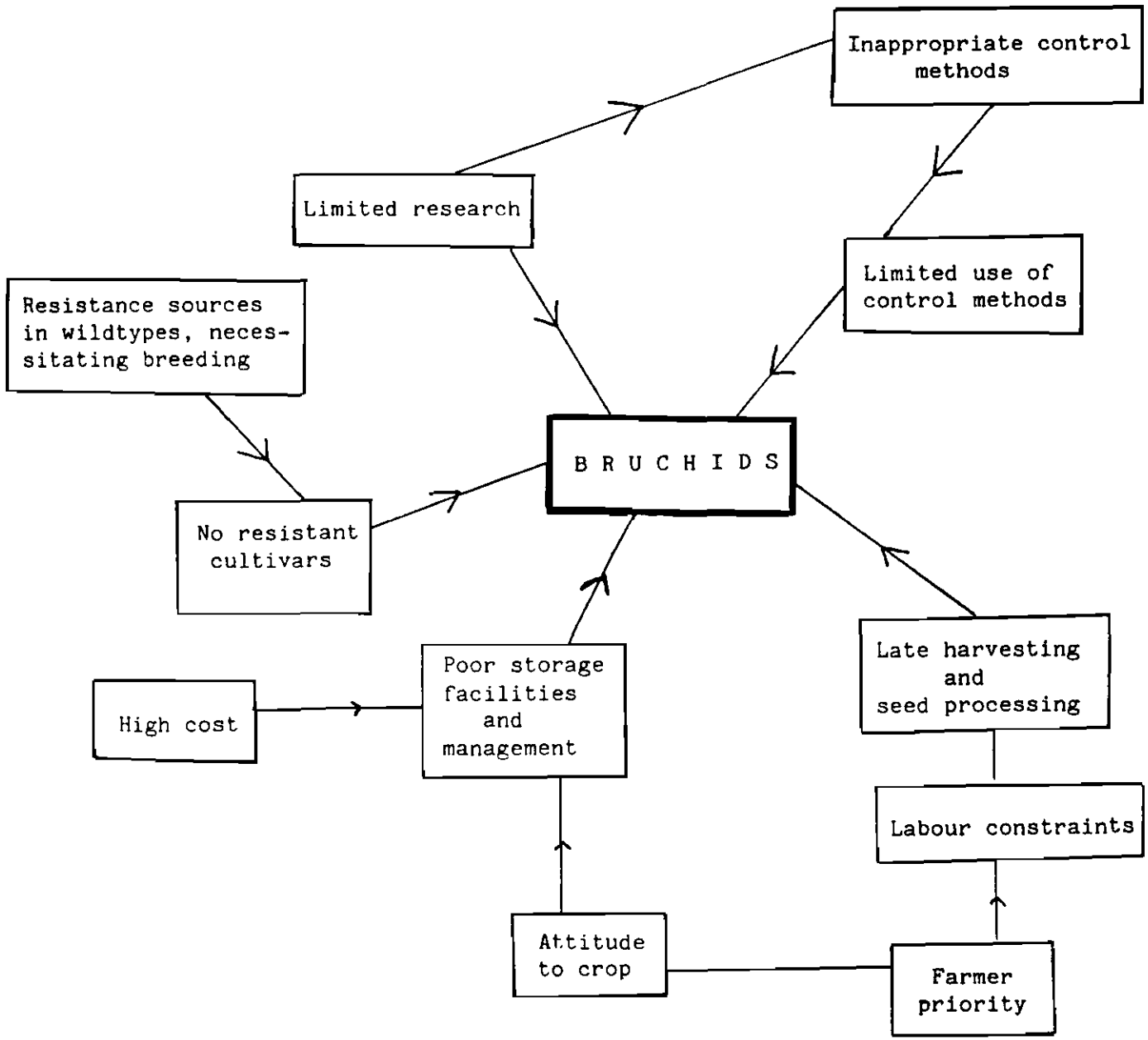
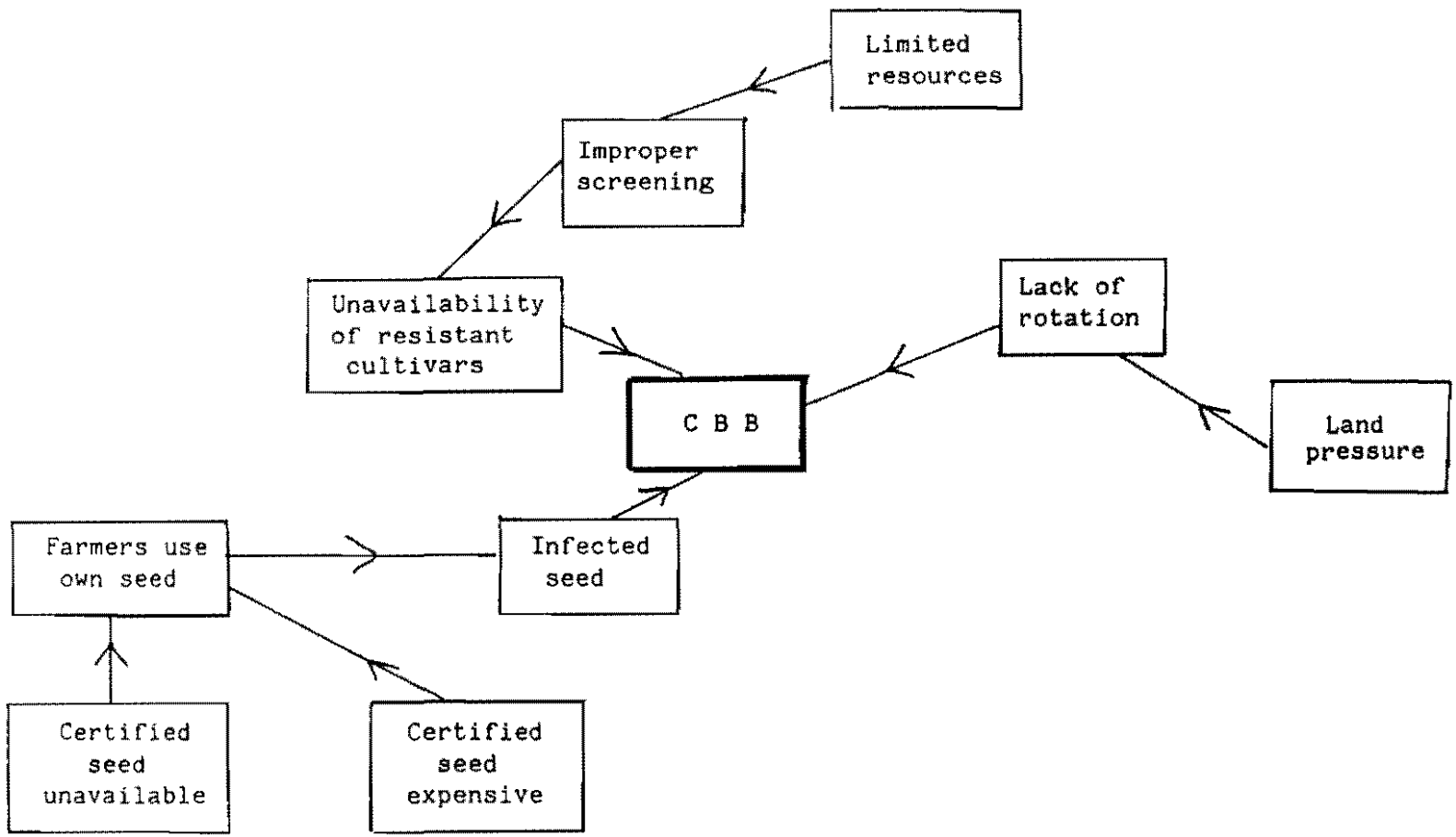


Fig. 7 Constraint No. 13 : COMMON BACTERIAL BLIGHT



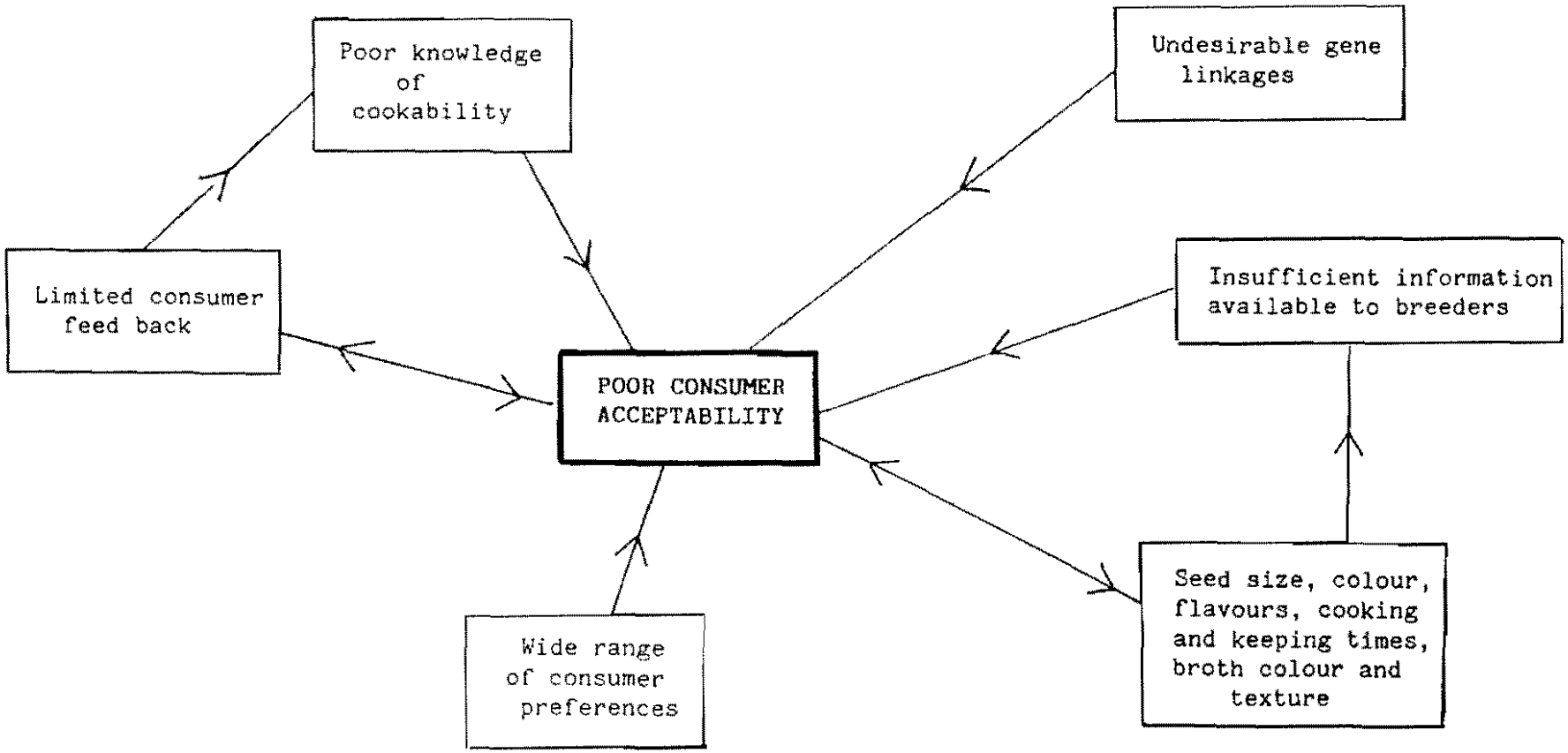


Fig. 8 Constraint No. 19 : POOR CONSUMER ACCEPTABILITY

Fig. 9 Constraint No.20 : B C M V

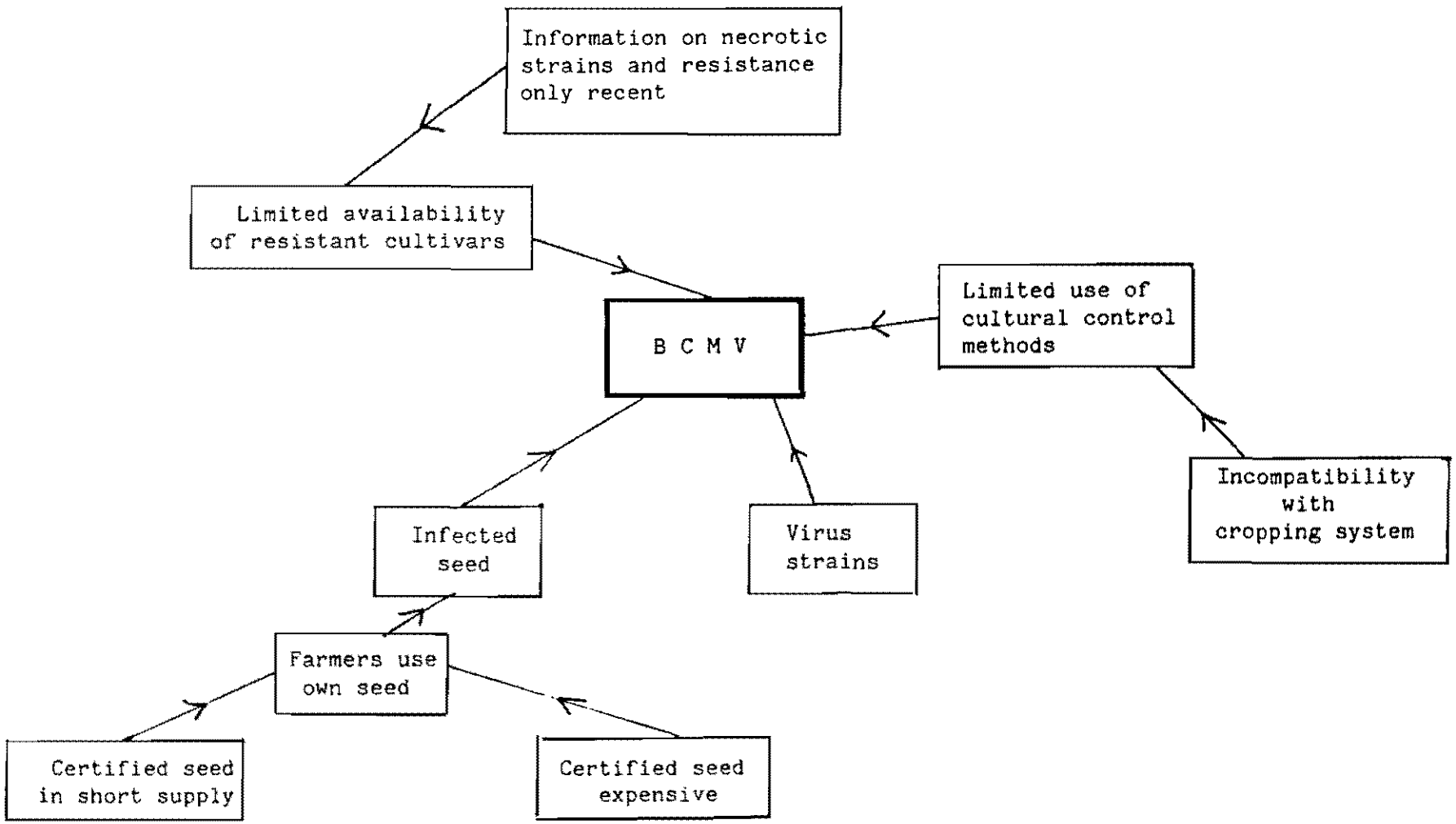
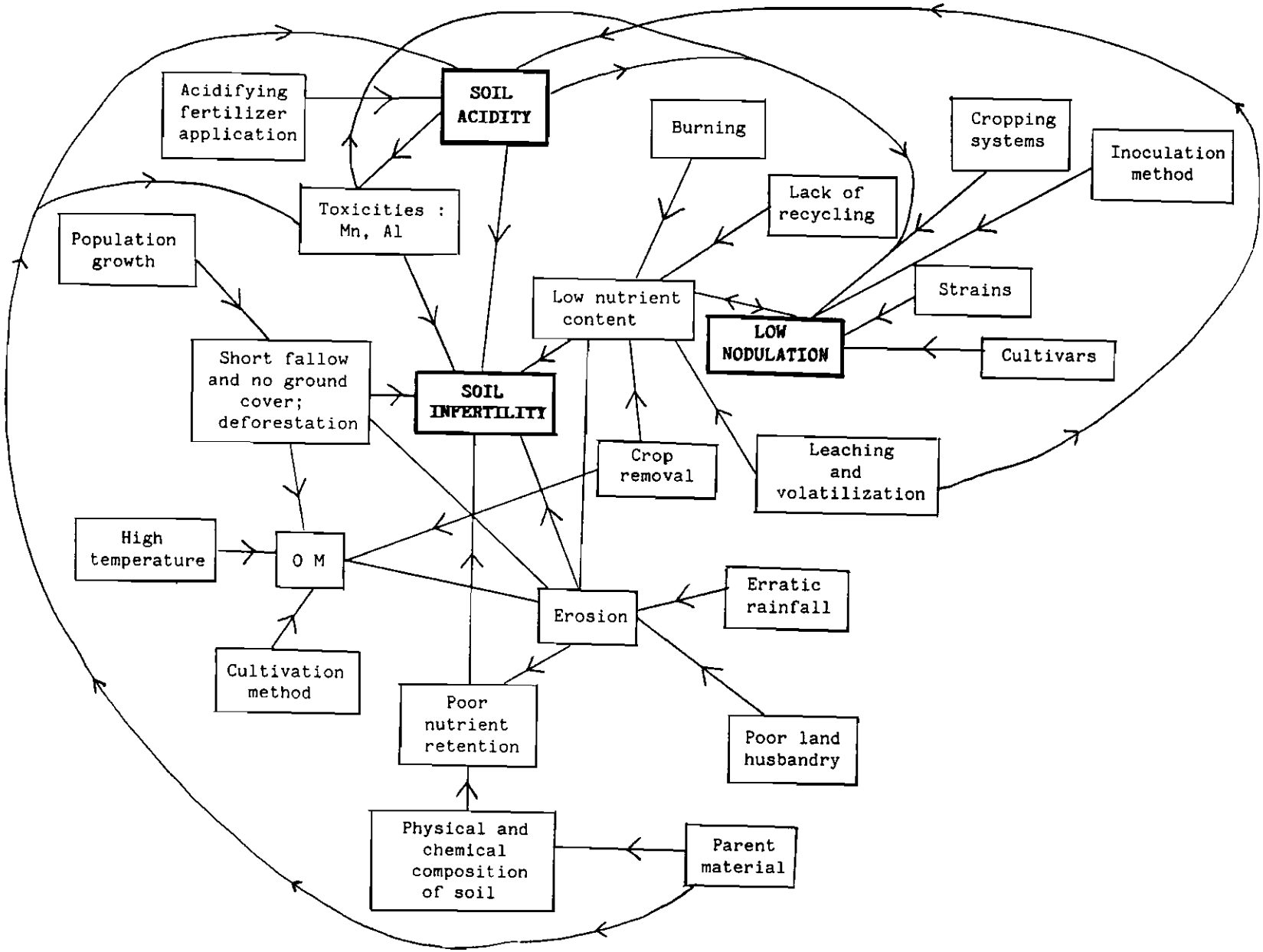


Fig. 10 Constraints Nos. 7, 8 and 11 : SOIL ACIDITY, SOIL INFERTILITY AND LOW NODULATION



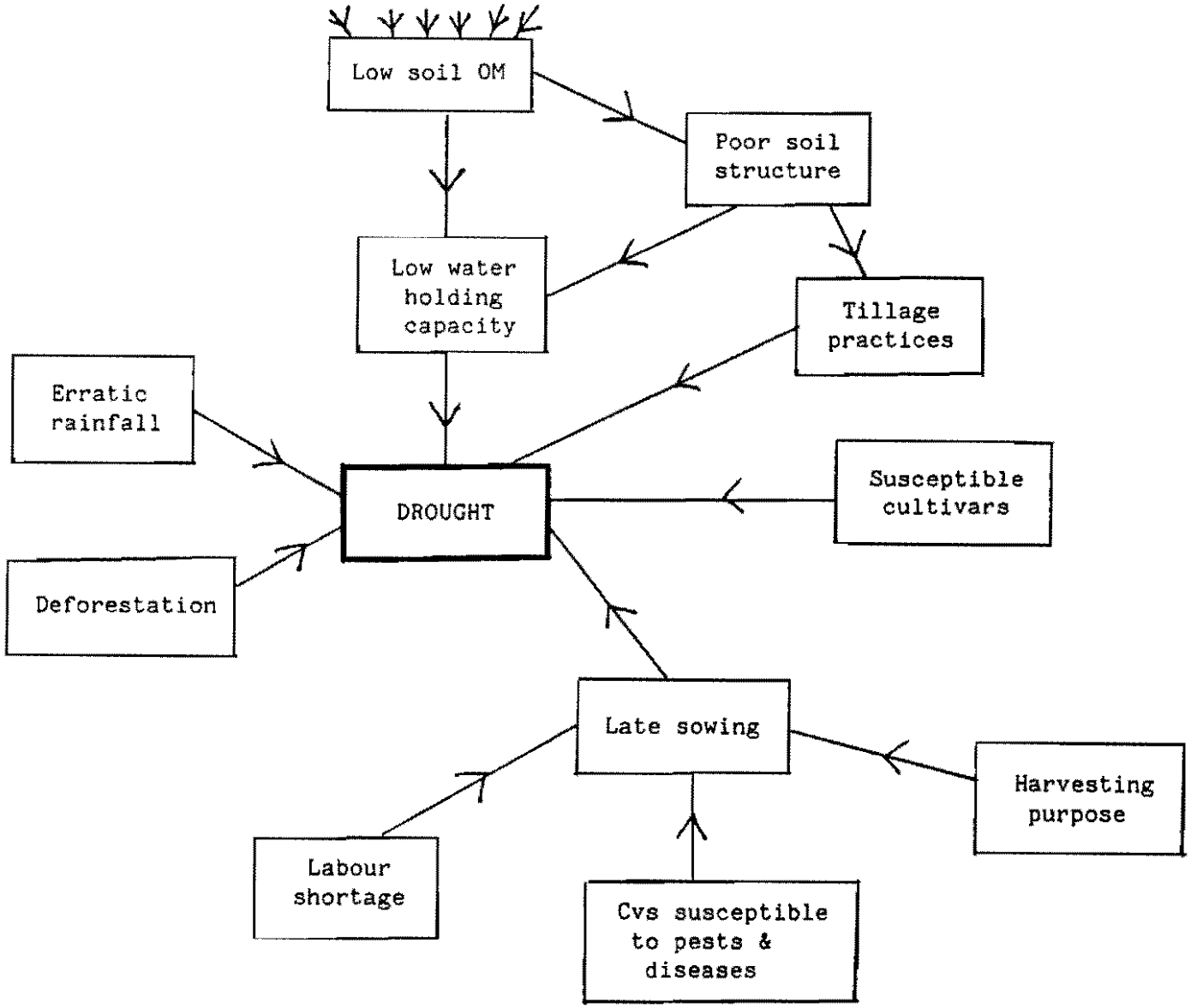
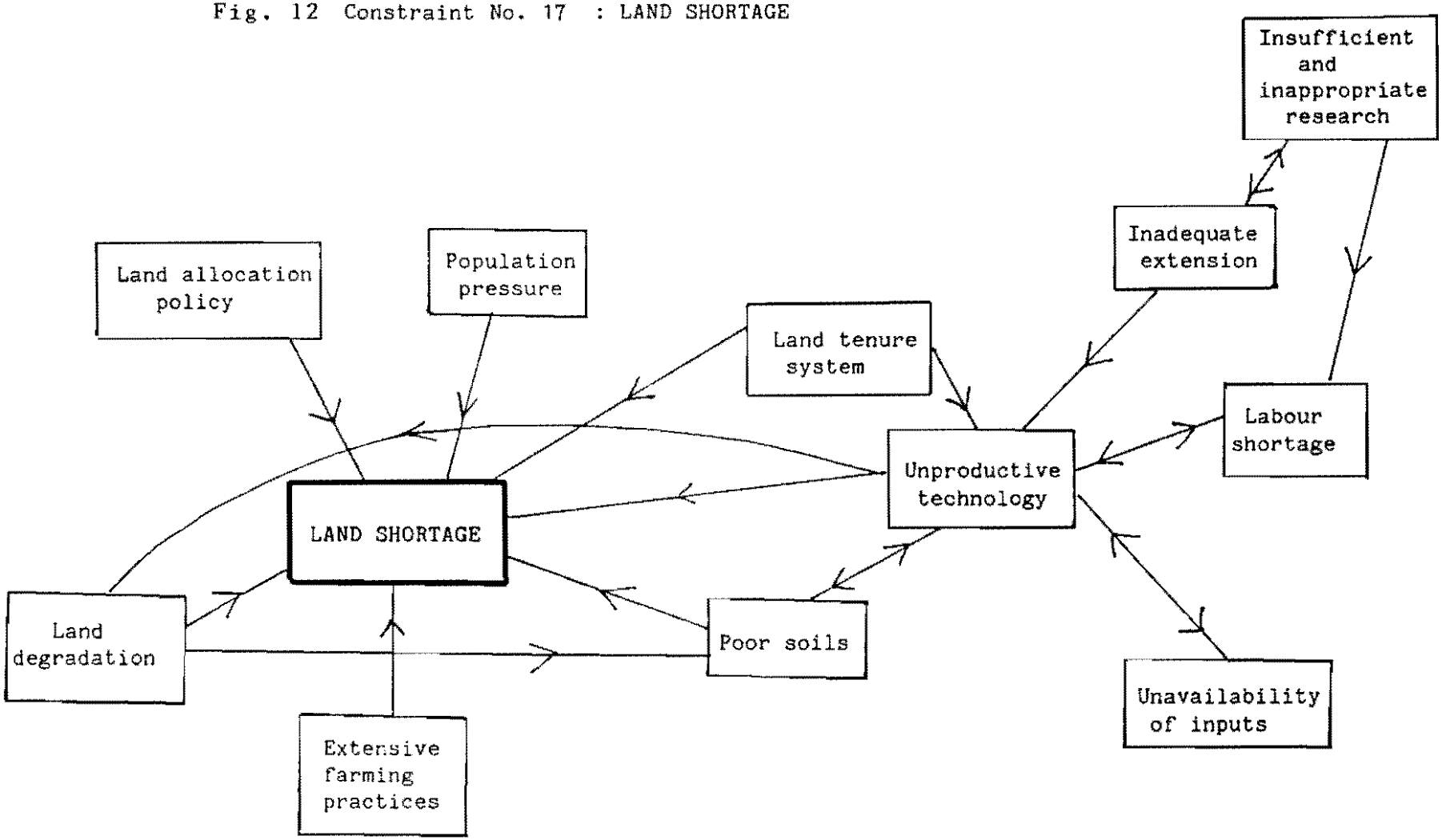


Fig. 11 Constraint No. 6 : DROUGHT

Fig. 12 Constraint No. 17 : LAND SHORTAGE



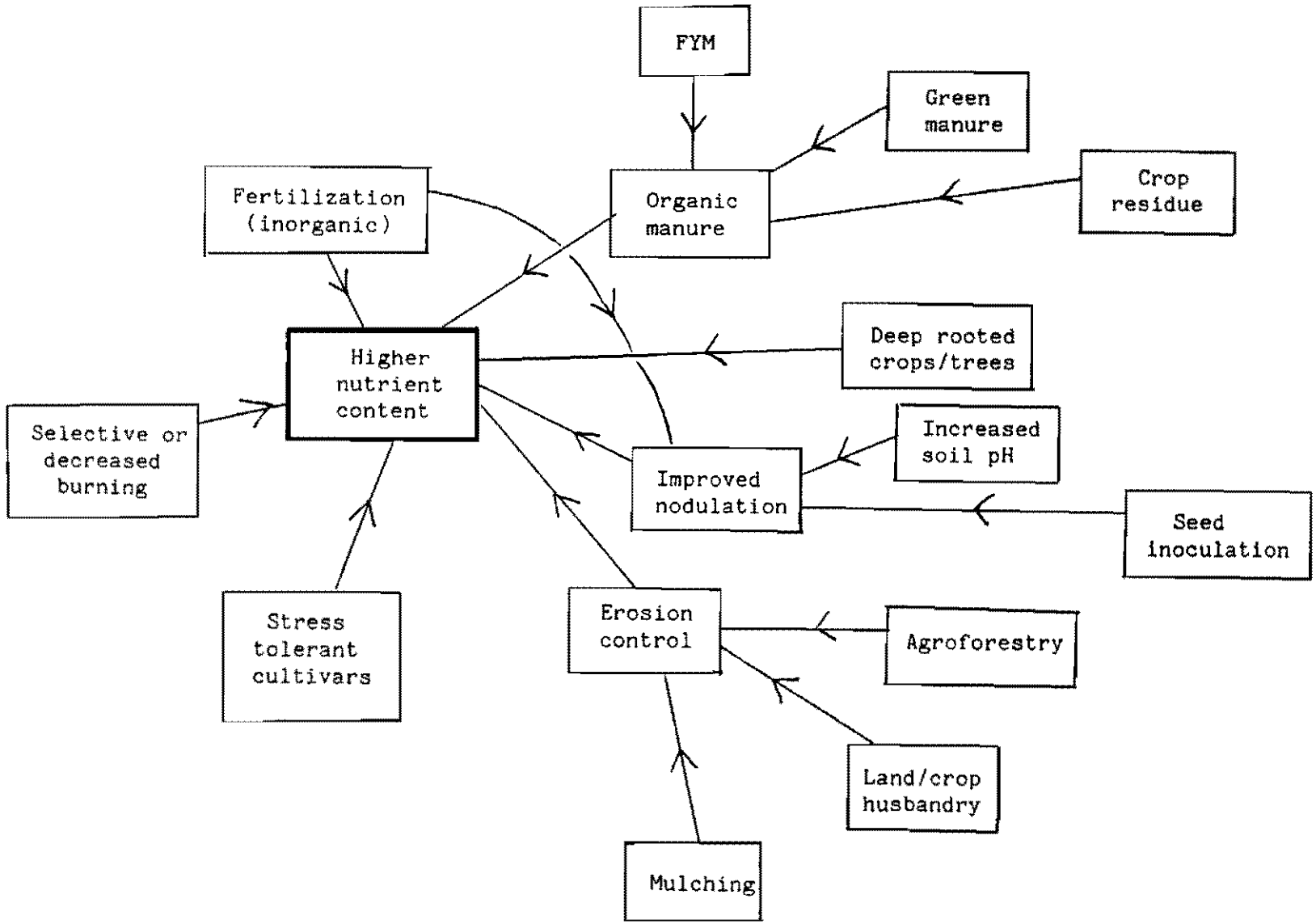


Fig. 13 POTENTIAL SOLUTIONS TO COMPONENTS OF SOIL INFERTILITY

1. LOW NUTRIENT CONTENT

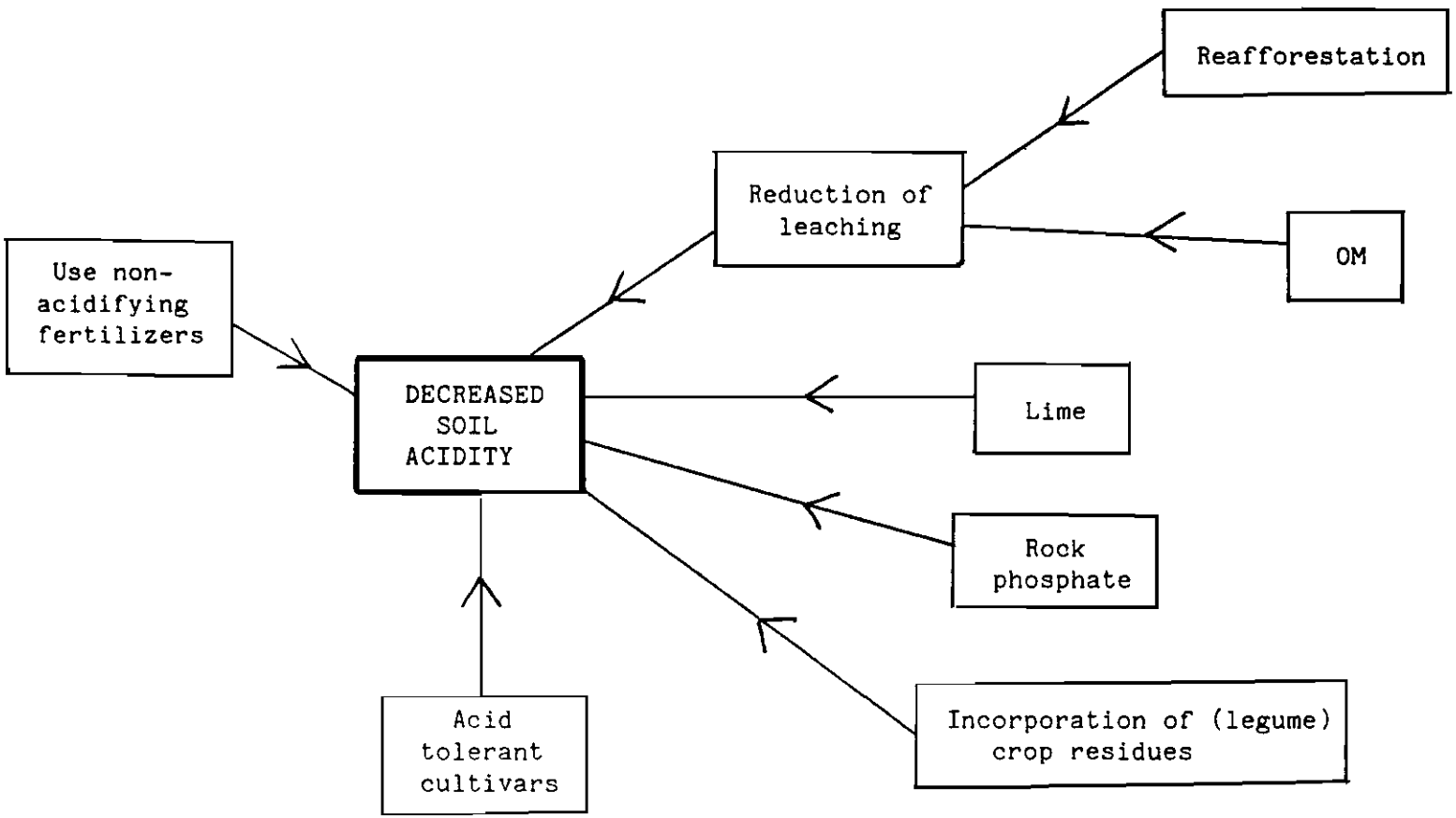


Fig. 14 POTENTIAL SOLUTIONS TO COMPONENTS OF SOIL INFERTILITY :
2. SOIL ACIDITY

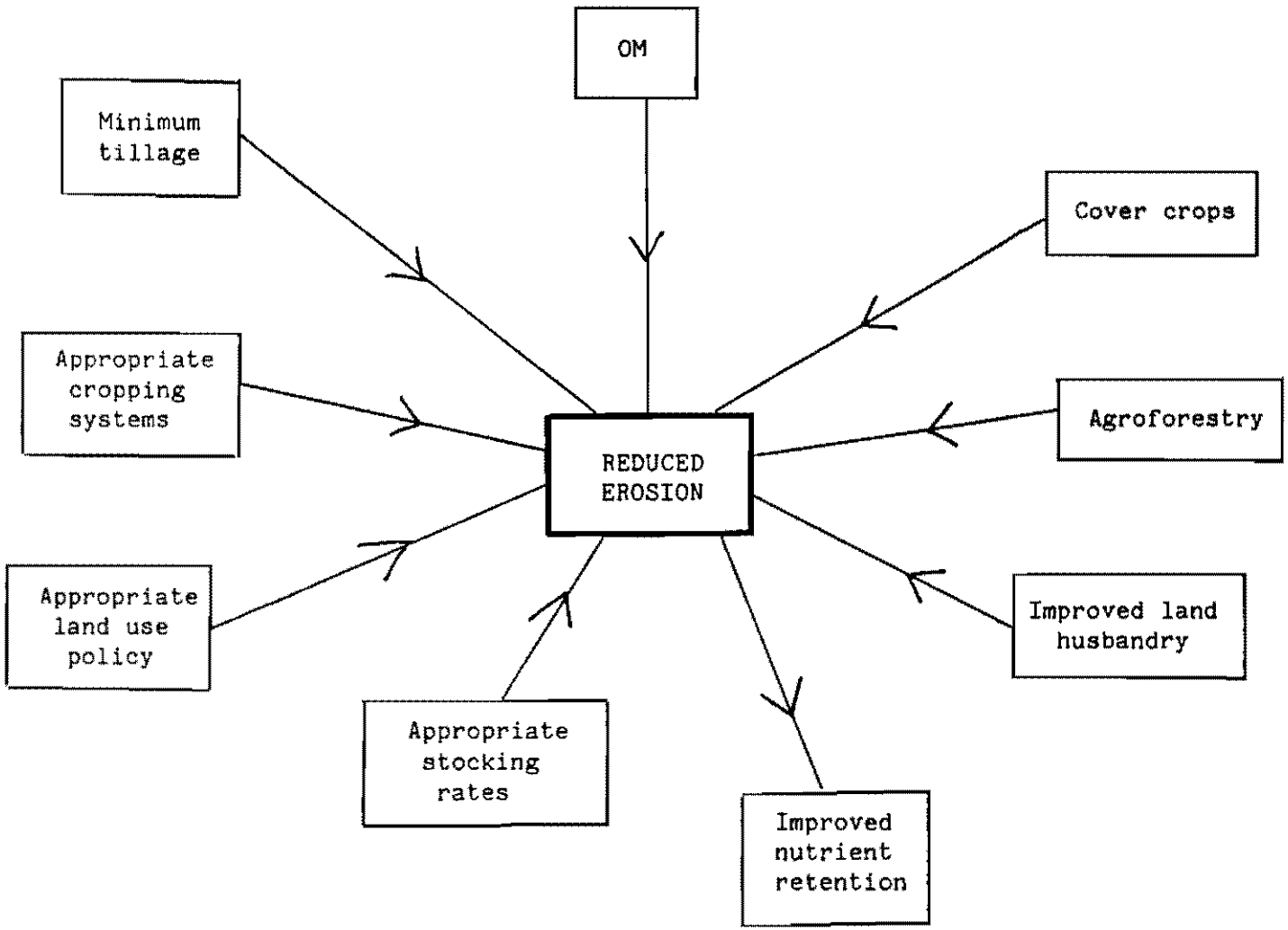


Fig. 15 POTENTIAL SOLUTIONS TO COMPONENTS OF SOIL INFERTILITY

3. SOIL EROSION AND NUTRIENT RETENTION

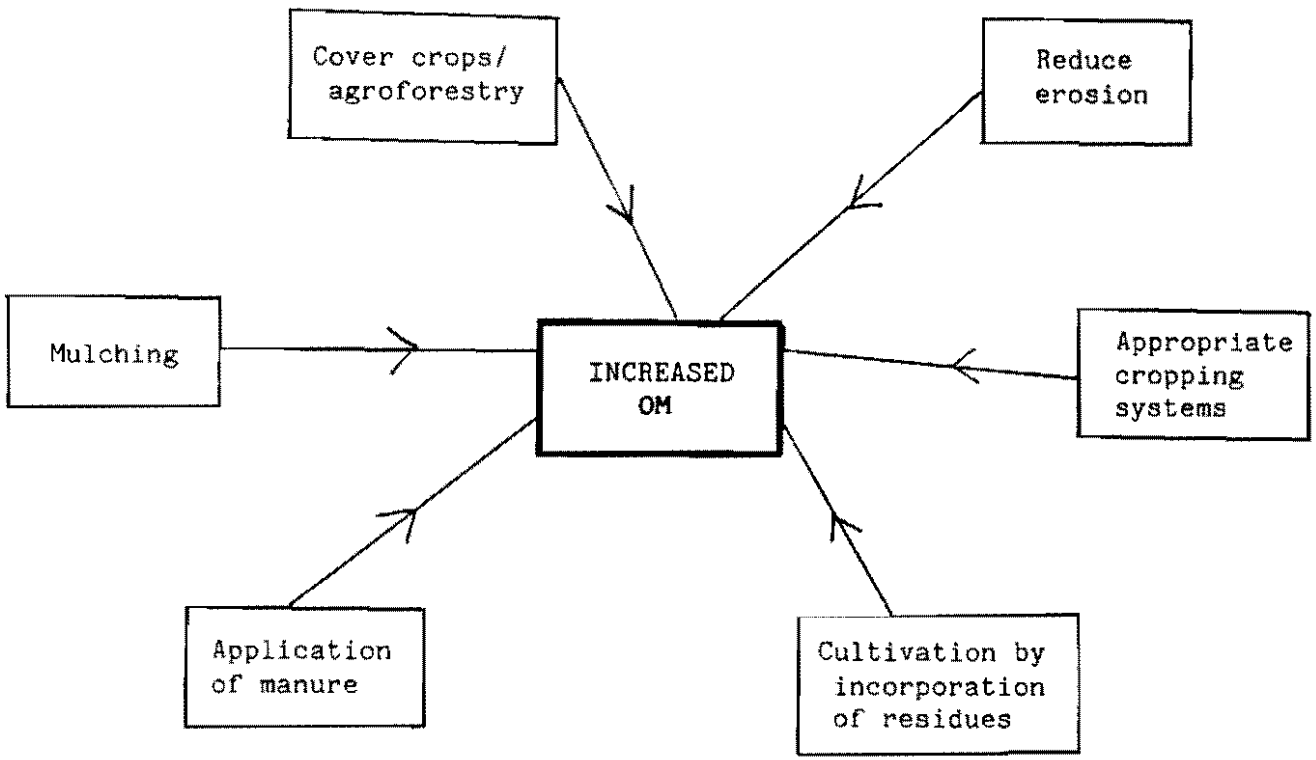
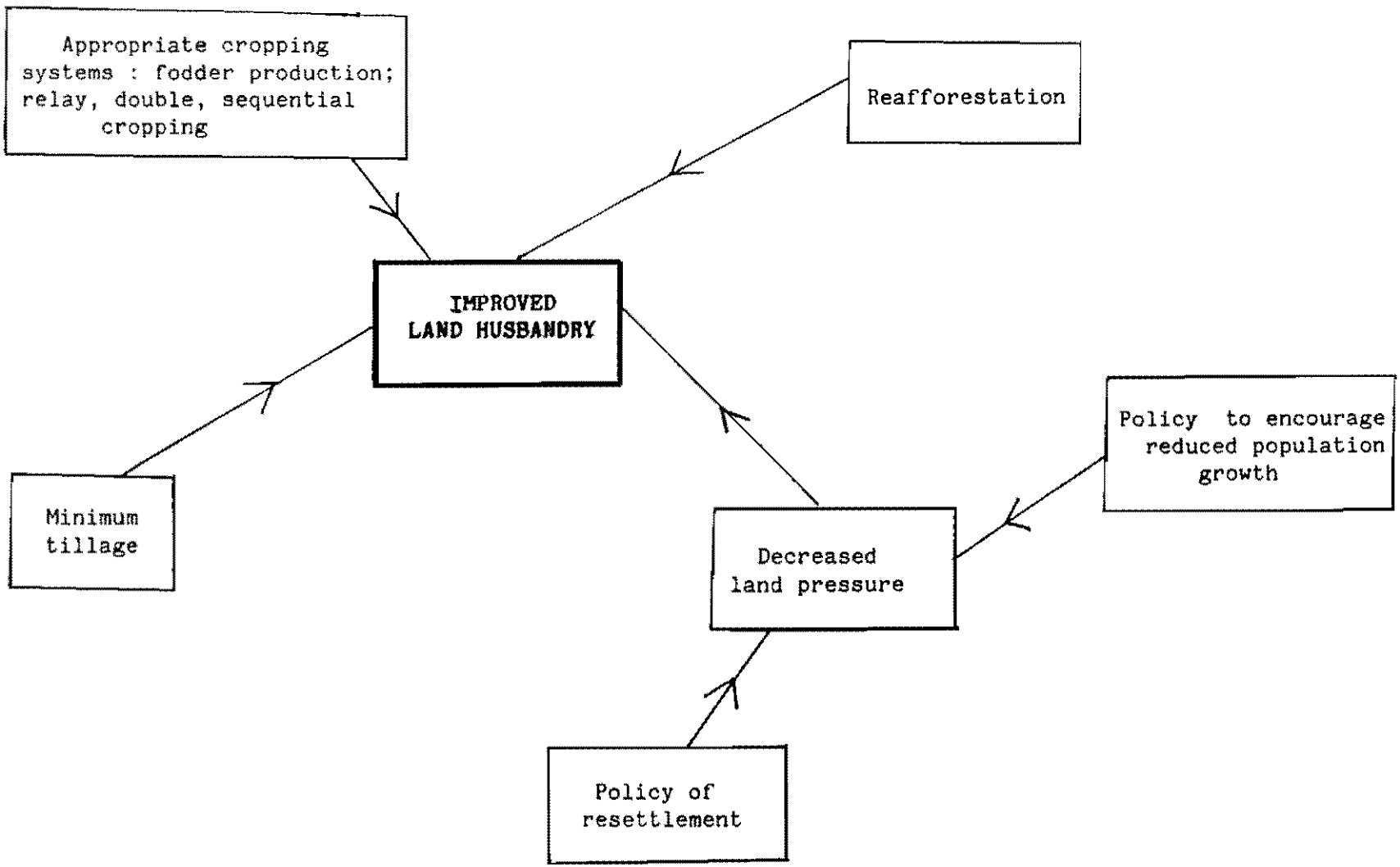


Fig. 16 POTENTIAL SOLUTIONS TO COMPONENTS OF SOIL INFERTILITY

4. LOW ORGANIC MATTER CONTENT

Fig. 17 POTENTIAL SOLUTIONS TO COMPONENTS OF SOIL INFERTILITY :
5. SHORT FALLOW, NO GROUND COVER/DEFORESTATION



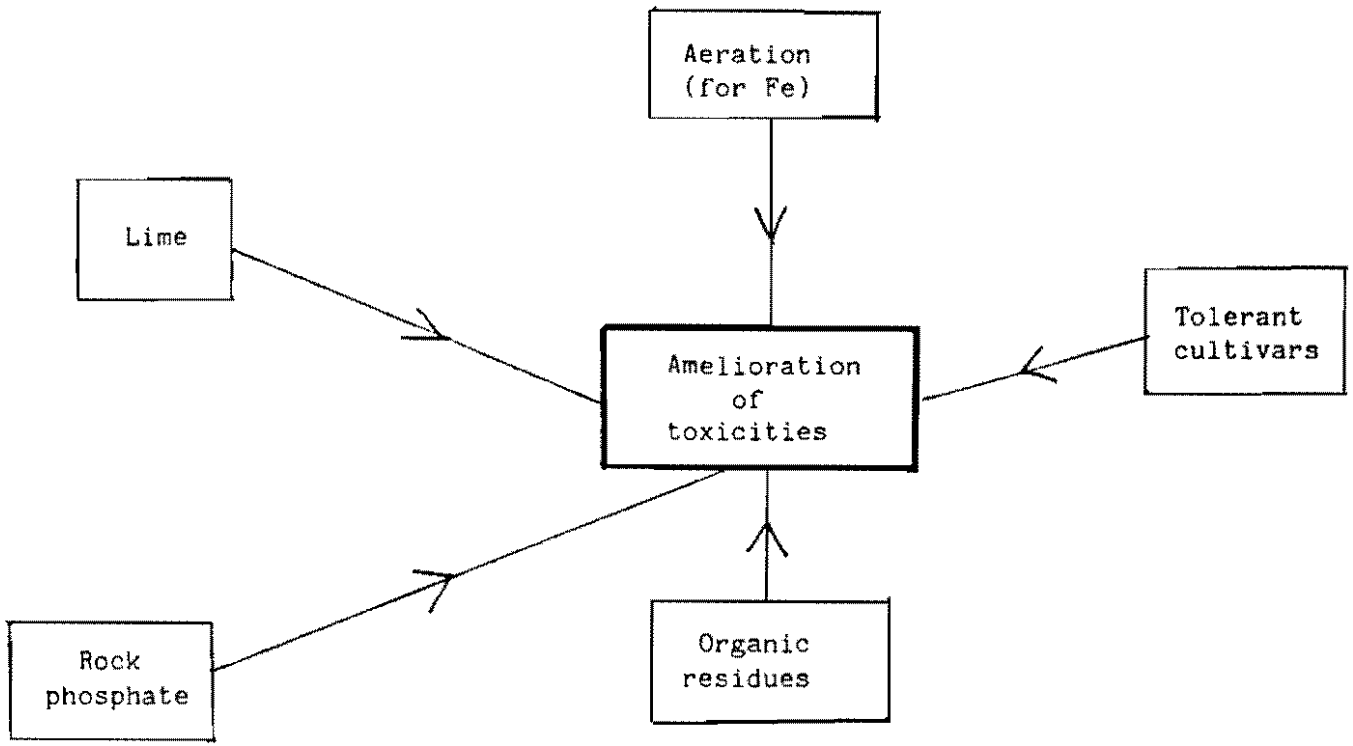
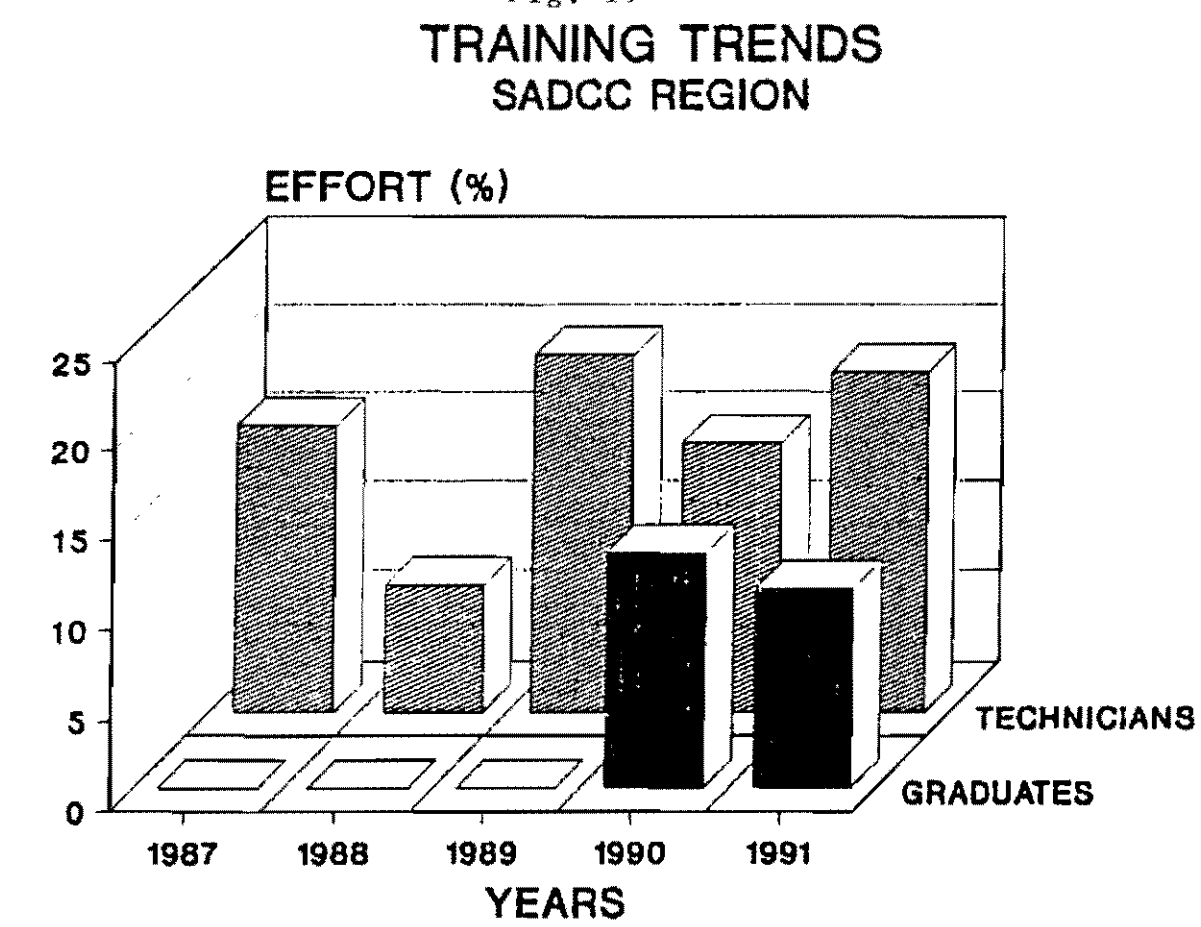


Fig. 18 POTENTIAL SOLUTIONS TO COMPONENTS OF SOIL INFERTILITY

6. ELEMENT TOXICITIES

Fig. 19



TRAINING TRENDS IN SADCC REGION 1987-91

Appendix 1. Participants[1] in a workshop to plan phase II of the SADCC/CIAT Regional Programme on Beans in Southern Africa. Club Makokola, Mangochi Malawi, 6-8 March, 1991

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[1] The national coordinators of bean research from Botswana, Lesotho, Namibia and Zimbabwe were invited but unable to attend. Two outstanding bean scientists, one each from Uganda and Zaire, both CIAT bean prize laureates, were also invited but unable to participate.

[2] Facilitors and Resource Persons.