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IMPROVING FOOD CROP PRODUCTIVITY IN THE COASTAL SANDY AREA OF THE THUA THIEN HUE PROVINCE CENTRAL VIETNAM

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SURVEY OF BIOTIC AND ABIOTIC CONSTRAINTS FOR CROP GROWTH (RICE, PEANUT AND CHILLI INSECT PESTS, DISEASES AND FARMERS' CROPPING PRACTICES) IN THE COASTAL SANDY AREA OF THUA THIEN HUE PROVINCE,CENTRAL VIETNAM

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SUMMARY

Thua Thien Hue province located on the Central part of Vietnam, still has a large cultivating area (Coastal area- rainfed lowland area). This is an area of poor soil and acid soil where drought, flood and particularly pests occur annually while the irrigation system has not been fully established. The average yield of crops is low due to biotic and a-biotic constraints whose main causing factors are *unfavourable farm practicing and pests*.However, there is a potential to increase its productivity through improved technology including improved crop practices and pests management. Methodology is adapted from the one developed by S. Savary et al. (1996). The study bases on the field surveys for the presence or absence of pests on 3 main crops: rice, peanut and chilli at several crop stages and on the use of correspondence analysis to analyze the results. The survey has conducted during Winter Spring crop from 2004 to 2005. Six villages were chosen as the representatives of the prevailing production situations of the coastal area in Thua Thien Hue Province. The results show that, for rice crop, fields having very low yield Y1 concentrate at area 2 (Coastal area- Quang thai commune, Quang dien distrist) (1) Biotic constraints include DE1 (dead heart), LF2 (Leaf folder); BP3 (Brown planthopper); WA2 (Weed above the canopy); DR2 (white flower); SHB3 (Sheath blight); DE1; LB2 (Leaf blast); NBS3 (Narrow brown spot). (2) Abiotic constraints include N1 (N fertilizer input); P1 (P fertilizer input); K1(K fertilizer input); NA2 (Pesticide applied at least two time); ND1(Nutrient deficiency at least one visit); NP1 (NPK fertilizer applied); DF4 (Duration of fallow). For peanut crop, fields having very low yield Y1 concentrate at area 1 (Coastal area- Phong hoa commune, Phong dien distrist) (1) Biotic constraints are AP2 (aphids); LF2 (Leaf folder); WB2 (Weed below the canopy); WB3; BL2; BL3 (Later leaf spot); BS3 (early leaf spot). (2) Abiotic constraints consist of PP3 (Plant x plant); NA3 (insecticide applied); ND1, ND2 (nutrient deficiency); T11(the first fertilizer applied - top dress); T21 (second fertilizer- top dress); K0 (No K fertilizer applied); LI0 (no lime applied); N2 (N fertilizer applied); M1 (manure applied); RR1 (row x row); P1 (P fertilizer applied). For chili crop, very low yield Y1 concentrates at 3 areas (1) Biotic constraints are Frog-eye Leaf spot (LS2), Cucumber mosaic (CM2), Chili thrips (CT2), aphids (AP2), and cut wollworm (CW2). (2) Abiotic constraints include NL1 (Number of leaves per branch), NF1 (Number of flowers per branch, low), FA1 (field area = smal), WS1 (Water status: dry), FR1, (Number of fruits per branch) and CS2 (Crop status : Bad).

TÓM TẮT

Vùng đất cát ven đầm phá sản xuất chủ yếu dựa vào nước trời ở Thừa Thiên Huế đất đai nghèo dinh dưỡng, chua phèn, hạn hán và thường bị lũ lụt, hệ thống thuỷ lợi chưa hoàn chỉnh và đặc biệt dịch hại cây trồng luôn xuất hiện gây hại hàng năm. Năng suất trung bình của nhiều loại cây trồng ở đây vẫn còn rất thấp nguyên nhân do các nhân tố hạn chế (sinh học và phi sinh học) trong đó các biện pháp kỹ thuật canh tác bất hợp lý của nông dân và dịch hại là các nhân tố hạn chế chủ yếu. Quá trình khảo sát đã áp dụng phương pháp do S. Savary và các cộng sự đề xuất năm 1996. Sự nghiên cứu dựa vào việc khảo sát các biện pháp kỹ thuật nông dân áp dụng và các loài dịch hại xuất hiện trên các cánh đồng của 3 cây trồng chính lúa, lạc và ớt và sử dụng phân tích phù hợp (correspondence analysis) để phân tích các kết quả thu được. Quá trình khảo sát được tiến hành trong vụ Đông xuân năm 2004-2005 tại 6 làng đại diện cho sản xuất của vùng ven đầm phá ở Thừa Thiên Huế. Kết quả cho thấy đối với cây lúa các ruộng có mức năng suất rất thấp tập trung ở vùng 2 (xã Quảng Thái, huyện Quảng Điền) có quan hệ rất chặt với (1) các biện pháp kỹ thuật canh tác bất hợp lý mà nông dân áp dụng như: bón phân đạm, lân và kali ở mức rất thấp, thời gian bỏ hoá quá dài, cây thường biểu hiện thiếu dinh dưỡng ít nhất một lần thăm đồng; và (2) các dịch hại gây hại ở mức cao như: sâu đục thân gây khô tim ở mức 1, bông bạc ở mức 2, cuốn lá ở mức 2, khô vằn ở mức 3, đạo ôn lá ở mức 2, đạo ôn cổ bông ở mức 1, và đốm nâu ở mức 3. Đối với cây lạc năng suất rất thấp tập trung chủ yếu ở vùng 1 (xã Phong Hoà, huyện Phong Điền) có quan hệ rất chặt với (1) các biện pháp kỹ thuật bất hợp lý như: không bón vôi,

bón lân ở mức thấp, không bón kali, bón phân chuồng ở mức thấp, không bón lót chỉ bón thúc nhưng lượng bón rất thấp, mật độ gieo trồng cao do tỷ lệ cây sống sau gieo thấp và (2) các loài dịch hại ở mức gây hại cao như: rệp hại lạc ở mức 2, cuốn lá ở mức 2, cỏ dưới tán ở mức 2, đốm đen ở mức 2 và 3, đốm nâu ở mức 3. Đối với cây ớt năng suất rất thấp xuất hiện ở cả 3 vùng và có quan hệ chặt với (1) các biện pháp kỹ thuật bất hợp lý như: ruộng thường bị khô hạn, diện tích gieo trồng ở mỗi nông hộ nhỏ manh mún, cây biểu hiện thiếu dinh dưỡng, số là, hoa và quả trên cành thấp và (2) các dịch hại chủ yếu như: bệnh đốm mắt cua ở mức 2, bệnh vi rút Cucumber mosaic virus ở mức 2, bọ trĩ ở mức 2, rệp ở mức 2 và sâu khoang mức 2.

INTRODUCTION

Thua Thien Hue province located on the Central part of Vietnam, still has a large cultivating area (Coastal area- rainfed lowland area). This is an area of poor soil and acid soil where drought, flood and particularly pests occur annually while the irrigation system has not been fully established. The average yield of crops is low due to biotic and a-biotic constraints whose main causing factors are *unfavourable farm practicing and pests*. However, there is a potential to increase its productivity through improved technology including improved crop practices and pests management [2]. A targeted approach to assess losses caused by pests is a major issue because it provides a basic to determine priorities and to allocate resources in agricultural research. Yield losses are due to pests' variation with changes in production situation. It is important to characterize pests constraints in the context of production intensification because it allows quantification of the risk associated with changes in production [1].

Methodology is adapted from the one developed by S. Savary et al. (1996). The study bases on the field surveys for the presence or absence of pests on 3 main crops: rice, peanut and chilli at several crop stages and on the use of correspondence analysis to analyze the results. The survey has conducted during Winter Spring crop of 2004-2005. Six villages were chosen as the representatives of the prevailing production situations of the coastal area in Thua Thien Hue Province.

OBJECTIVES

General objective

Understanding the farmers'cropping practices, pest profiles and yields in farmers' fields in rainfed lowland area at Thua Thien Hue province, Central Vietnam is the main objective of this study. Besides, this study also aims to find some practical technique to improve the yields. It is thought that its information is important for further researching in this area especially for transferring technology to farmers.

Objectives

This study is conduceted with the hope:

To identify rice, peanut and chilli pests in household's crop fields at rainfed lowland area in Thua Thien Hue province, Central Vietnam.

To characterize the patterns of cropping practices and more generally achieve a reasonable description of production situations (environment factors that may determine actual yield of any above crops. This must include field operation).

To characterize the combination of pests that may occur in any particular field,

To establish links between production situation of pests combinations of each crop

To generate a measure of the link between production situations, pest combinations, and variation in actual yield of each crop

MATERIAL AND METHODS

This survey is meant to address the individual farmer's field. The system here includes a farmer's field and it encompasses components such as the crop at its various development stages, the farmers (and field operations such as crop establishment techniques, crop husbandry practices, and inputs) and the pests that may affect the standing crop throughout its cycle from crop establishment to harvesting. In this survey, any harmful agent that may reduce yield such as weeds, insects, and pathogens are referred to as pests.

Any survey must address an adequate number of fields so that it is possible to do analysis, formulate hypotheses, and forward interpretations.

In this study, the methodology is adapted from the one developed by S. Savary et al. (1996) [5]. Each crop based on the field survey of for the presence or absence of pests at several crop stages. Correspondence analysis is emloyed to analyze the results.

The survey was conducted during Winter Spring crops from 2004-2005.
4 villages were chosen to represent the prevailing production situations of the three studied regions.

3 crops (rice, peanut and chilli crops)

4 villages / 3 communes

8 farmer fields/crop / village

32 fields per crop, total 96 fields were surveyed

For pests identifying at lab

For insect identifying

Use picture and resource of Crop Protection compendium 2002

For detecting fungi and nematode

For diseases diagnostic, some common diseases can be accurately diagnosed in the fields by visual symptom. Diseases that have similar non-specific symptom have to be identified by typical symptoms collected from infected crop. The symptoms are then identified in the laboratory by examining samples using stereomicroscope and compound microscope and, by isolation into pure cultures or by hypersensitivity and inoculation[3, 4, 7].

For detecting bacteria [8]

1. Seedling symptom test: (using Cassette holder method and Roll towel method)
2. Bacterial characters and test used: Gram reaction (using Potassium hydroxide solubility test); Biochemical tests (Arginine dihydrolase, Kovac's oxidase test, Gelatine hydrolysis, Starch hydrolysis, and Oxidative/fermentative (O/F).
4. Liquid assay: each seed sample was ground up and incubated in 200 ml sterile saline solution for 2 hours. The suspension was serial diluted and aliquots were plated on to medium (NA, KB). Serological testing and pathogenicity identified the isolated bacteria.

5. Inoculation test (Using Hypersensitive reaction test (Tobacco, pepper plant); and pathogenicity test (Using cutting leaves inoculation and stem inoculation).
For detecting virus
1. Typical symptom in fields [7]
Growing on test
Indicator plant test

RESULTS

Rice crop survey
Result of rice survey
Major rice insect pests on the sandy soil in Thua Thien Hue Province

Eleven insect pest species have been identified in which Cnaphalocrocis medinalis, Nilaparvata lugens are very seriously widespread. In terms of diseases, there are 5 kinds of diseases in which Rhizoctonia solani K., Cercospora oryzae M. and Grain discoloration are very widespread and serious. Six weed species, of which the most widespread belong to Echinochloa crus-galli, Leptochloa chinensis and Monochoria vaginalis (table 1).

Table 1. Major rice insect pests on the sandy soil in Thua Thien Hue Province

Scientific Name	Order	Family	English/Vietnamese Common Name	Distribution & importance
Major insects				
Cnaphalocrocis medinalis	Lepidoptera	Pyralidae	Leaf folder/sau cuon la nho	+ + +
Scirpophaga incertulas W.	Lepidoptera	Pyralidae	Yellow stem bore/duc than 2 cham	+ +
Chilosupperessalis	Lepidoptera	Pyralidae	/5 vach dau nau	+
C. polychrysus	Lepidoptera	Pyralidae	/ 5 vach dau den	+
Spodoptera litura	Lepidoptera	Noctuidae	/sau keo	+
Melanilis leda ismene	Lepidoptera	-	/ sau buom mat ran	+
Oxya sp.	-	-	/ chau chau lua	+
Nilaparvata lugens	Hemiptera	Delphacidae	/ray nau	+ + +
Nephotettix spp.	Hemiptera	Delphacidae	/ray xan duoi den	++
Sogatella furcifera	Hemiptera	Delphacidae	/ ray lung trang	+
Leptocorisa oratorius	Hemiptera	Alydidae	/ bo xit dai	++
Major diseases				
Pyricularia oryzae	-	-	/Dao on lua	+ +
Rhizoctonia solani K.	-	-	/kho van	+ + +
Cercospora oryzae M.	-	-	/Dom nau	+ + +
Grain discoloration *	-	-	-	+ + +
Major weeds				
Cyperus difformis L.	-	Cyperaceae	/co lac mo	+ +
C. iria	-	Cyperaceae	/co Lac	+ +
Echinochloa crus-galli	-	-	/co long vuc nuoc	+ ++
Fimbristylis miliaces	-	-	/ co chat	+ +
Leptochloa chinensis	-	-	/ co duoi phuong	+ ++
Monochoria vaginalis	-	-	/ rau mac	+ ++

Note:
+ + + very widespread and very serious
+ + widespread and serious
+ locally serious

Correspondence analysis

The data compact a range of the cropping practices (categorization of the information) and pest data over time shown in table 2.

Table 2. Data compaction over ranges: categorization of the information (cropping practices and pests)

Variable	Categories
AC	Average crop status
A	Area where is study site: A1: area 1 (Duc Phu, Phong Dien district), A2: area2 (Quang Thai, Quang Dien district) A3: area 3 (Vinh Phu, Phu Vang district)
V	Village: V1: Dien Trung village (Phu Vang district) , V2: Nghia Lap village (Phu Vang district), V3: Duc Phu village (Phong Dien district), and V4: Trung Kieu village (Quang Dien district)
DF	Duration of fallow period : DF1: 1-3 months; DF2:>3- 4 months; DF3: >4- 5 months DF4: >5- 6 months
X21	Name of rice variety (wide used variety)
KD	Name of rice variety (wide used variety)
CD	Crop density: CD1: below 250 plant/ s.q.m, CD2: >250-320; CD3: >320 – 380
M	Manure application: MO: no manure application, M1: 1000-3000 kg/ha M2: >3000 – 5000 kg/ha
N	N Fertilizer input: N1: 37- 75 kg/ha; N2: >75-116 kg/ha N3: >116-128 kg/ha
P	P Fertilizer input: P1:32-40 kg/ha; P2: >40-60 kg/ha; P3: >60- 80kg/ha
K	K Fertilizer input: K1: 24-36 kg/ha; K2: >36- 60 kg/ha; K3: >60- 84 kg/ha
NA	Insecticide use frequency: NAO: No insecticide application, NA1: one, NA2: two application.
ND	Nutrient deficiency: NDO: none nitrient deficiency, ND1: nutrient efficiency observed at one visit.
DR	DR0: No white flower; DR1: maximum DR incidence below 1%; ; DR2: above 1%
DE	DE: Dead heart: DE1: maximum DE incidence below 1%; DE2: >1-2%; DE3: >2%
ShB	SHb1: maximum severity below 110 %. dsu, SHB2: >110 – 240%.dsu; SHB3: >240 – 850%.dsu
NBS	NBS1: area under severity progress curve below 80%.dsu; NBS2: >80-170 %.dsu; NBS3: > 170-960 %.dsu
LB	LB0: No leaf blast; LB1: area under severity progress curve below 190%.dsu; LB2: . 190 – 970 %.dsu
BP	BP1: area Brown plant-hopper population progress curve below 40%.dsu; BP2: >40 – 160%.dsu; BP3: >160 – 920 %.dsu
LF	LF0: no leaf folder; LF1: area under LF injure progress curve below 550 N.dsu; LF2: > 550 – 5300 N.dsu
WA	WAO: no weed infestation above the canopy, WA1: area under WA progress curve below 300%.dsu; WA2: >300- 1400%.dsu
WB	WBO: No weed infestation below the canopy; WB1: area under WB progress curve below 500 %.dsu; WB2: >500 – 2660 %.du
Y	Y1: Yield below 2980 kg/ha; Y2: above 2980 and below 5000 kg/ha; Y3: above 5000 and below 5520 kg/ha; Y4: above 5520 and below 6100 kg/ha; Y5: above 6100 kg/ha

Two contingency tables were built: (1) yield across cropping practices (Y x PR) and (2) yield across pest profiles (Y x PE).

The yield across cropping practices contingency shows the distribution of individuals (fields) according to two categorized variables. It is able to see the yield profiles (horizontally) associated with a given cropping practice. This contingency table indicates that cropping practices are associated with variation in yields. We can see the yield profiles associated with study site A3 (2,4,1,3,and 6 fields) have moderate high yield, which differs from that of A2 (4,3,0,1,0). Similar findings can be recognised in the result of others such as yield profiles associated with Villages (V), Nutrient application N, P, K ... The chi-square value associated with the contingency table 5 is 998.012, df = 140, P = 0,00.

Correspondence analysis on the contingency (Y x PR) yielded two major axes. The first one accounted for 47% of the total inertia, the second for 36% (see Fig. 1). These two axes accounted for a large proportion of the total inertia, which needs interpretation. Axis 1 represents a gradient of increasing yields, the contribution of extreme yield classes are highest and show a change of sign of the contributions. Axis 1 incorporated strong contribution of A2, V2, SC1, N1, P1, K1, NA2, ND1, V4, X21, SC3, M1, N3, and NAO. Axis 2 represents yield categories medium yield (Y3) and very high yield (Y5). On this axis Y3 is associated with DF1, CD1, M1, M2, N2, P2.

The resulting graph (Fig.1.) is a path of increasing yields amidst the different categories of cropping practices profiles. When seeing with particular reference to cropping practices, the progress from high yield to very low yield is associated with a reduction of inputs and /or a decrease in the management of production factors. The move from Y5 to Y4 corresponds to a decline in fertilizer input (M1) or production factor (NA1, CD3, X21, only NPK application NP3, ..) the move from Y4 to Y3 corresponds to a decline in fertilizer inputs (N2, P2, M2, NP2,) from Y3 to Y1 corresponds to low fertilizer inputs or poor production factors (N1, K1, P1, NP1, DF4, NA2, ND1...), yields are highest at V4, A2 (Trung Kieu village, Quang Thai Commune) and lowest at V2, A3 (Nghia Lap village, Vinh Phu commune).

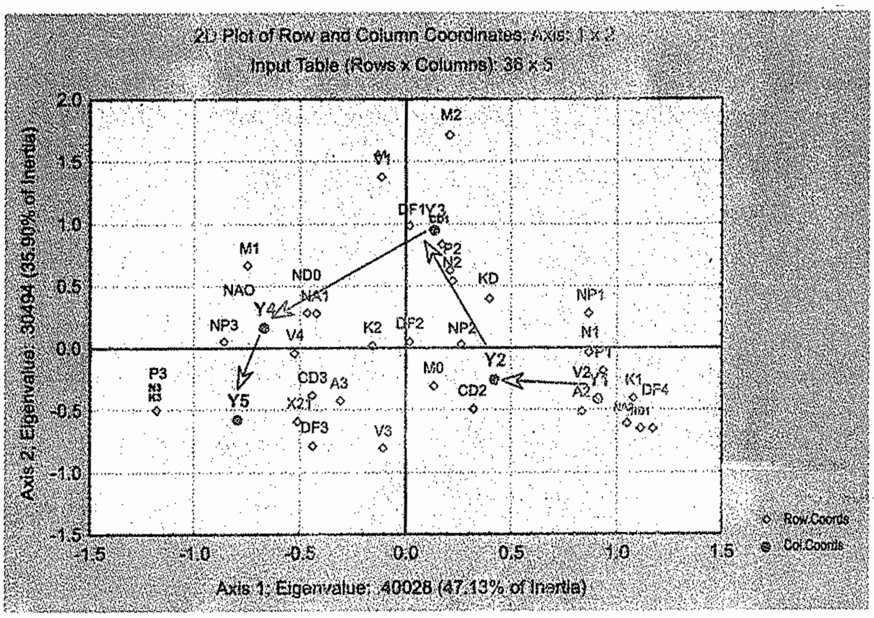

Fig. 1. The path of increasing yields among the different categories of cropping practices

The yield across pest profiles contingency shows similar observations. Some pest profiles were frequently associated with low yields (e.g., WB2, BP3...). The result indicates that the variation of yield and pest profiles were not independent. The chi-square value associated with this contingency table is 217.365, df = 104, p = 0.000.

Correspondence analysis on the contingency (Y x PE) yielded two major axes. The first accounted for 60.57% of the total inertia, the second for 16.43% (see Fig. 2). Since these two axes accounted for a large proportion of the total inertia, they should be considered for interpretation. Axis 1 represents a gradient of increasing yields, the contribution of extreme yield classes are highest and show a change of sign of the contributions. Axis 1 incorporated strong contribution of DE1, WA2, WB2, BP3, LF2, LB3, NBS3 and AHB3. Axis 2 represents at yield categories medium yield (Y2) and very high yield (Y4) and (Y5). On this axis Y2 is associated with DR1, WA1, BP2, LF1. Y4 is associated with LBO.

The resulting graph (Fig.3.) is a path of increasing yields amidst the different categories of pest profiles. Pest profiles can be associated with yields decline. Very low yield associated with pests affects rice crop at the highest levels. Considering the very low yield, Y1 is associated with WA2, WB2, BP3, LF2, LB2, SHB3, NBS3 or heavy drought stress DR2, and at low density DE1. On the contrary, very high yield (Y5) is associated with the nearly absence of all pests, except narrow brown spot (NBS2), and Sheath blight (SHB1). The move from Y5 to Y4 is associated with NBS1, LF1, SHB2, BP2. the move from Y4 to Y2 is associated with WA1, WB1, DR1, SHB1.

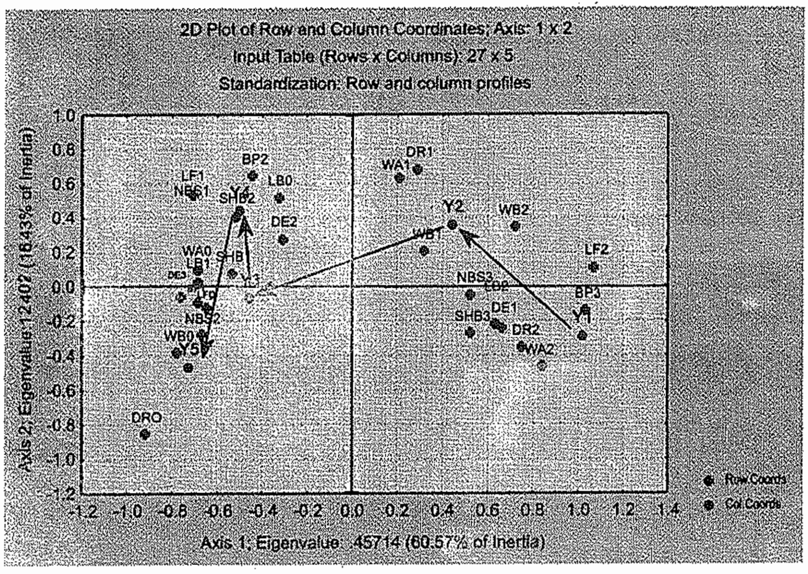

Fig. 2. The path of increasing yields among the different categories of rice pest profiles

The analysis suggests some main pest profiles that may contribute to yield reduce. They consist of weeds, insect pests such as Brown plant-hopper, leaf-folder and diseases such as Leaf blast, Narrow brown spot and Sheath blight. Control of these pests can result in higher yields.

Peanut crop survey

Major and important pests on peanut crop (Arachis hypogaea) in Thua Thien Hue Province

14 insect pest species have been identified. The most serious and widespread ones belong to Lamprosema diemenalis, Spodoptera litura, Epicauta gorhami M and Aphis craccivora. In terms of diseases, among 10 identified species, Mycosphaerella arachidis, M. berkelevii, Puccinia arachidis, Rhizoctonia solani, Aspergillus niger, Ralstonia solanacearum, and Peanut stripe virus are the most widespread and serious. Similarly, 9 species have been recognised. The most serious and widespread species belong to Ageratum conyzoides, Cynodon dactylon, Dactyloctenium aegyptium, and Eleusine indica (table 3).

Table 3. Major and serious pests on peanut crop (Arachis hypogaea) in Thua Thien Hue Province

Scientific Name	Order	Family	English /Vietnamese Common Name	Distribution & seriousness
Major insects				
Agrotis ipsilon	Lepidoptera	Noctuidae	Black cutworm/ (sau xam)	+ +
Helicoverga armigera	Lepidoptera	Noctuidae	Cotton bollworm/ sau xanh	+ +
Homona coffearia	Lepidoptera	Noctuidae	Tea tortrix / sau an la	+ +
Lamprosema diemenalis	Lepidoptera	Pyralidae	Soybean leaffolder/cuon la	+ + +
Spodoptera litura	Lepidoptera	Noctuidae	Taro caterpila/ sau khoang	+ + +
Heliothis spp.	Lepidoptera	Noctuidae	Leaf-eating caterpillar/sau rom	+ +
Aproderema modicella	Lepidoptera	Gelechiidae	Groundnut leafminer /cuon la lac	+ +
Epicauta gorhami M.	Coleoptera	Meloidae	Blister beetle / Ban mieu	+ + +
Aproaerema modicella	Lepidoptera	Gelechiidae	Groundnut leaf miner/ duc la	+ +
Bemisia spp.	Homoptera	Aleurodidae	/Bo phan	+
Hypomeces squamosus	Coleoptera	Curculionidae	Green weevil/ cau cau	+
Aphis craccivora	Hemiptera	Aphididae	Groundnut aphid/ rep muoi hai lac	+ + +
Caliothrips indicus	Thysanoptera	Thripidae	Black thrips/ bo tri den hai lac	+
Scirtpthrips dorsalis	Thysanoptera	Thripidae	Chilli thrips/ bo tri ot	+
Major diseases				
Mycosphaerella arachidis	Dothidales	Mycosphaerellaceae	Early leaf spot / dom nau lac	+ + +
M. berkelevii	Dothidales	Mycosphaerellaceae	Later leaf spot / dom den lac	+ + +
Puccinia arachidis	Uredinales	Pucciniaceae	Rust / gi sat	+ + +
Rhizoctonia solani	Ceratobasidiales	Ceratobasidiaceae	Seed rot / thoi hat (dau phung)	+ + +
Aspergillus niger	Class: Hyphomycetes		Collar rot, seed rot/ heo ru goc moc den, thoi hat	+ + +
Aspergillus flavus	Class: Hyphomycetes		Seed rot / thoi hat moc vang xanh	+ +
Sclerotium rolfsi	Stereales	Corticiaceae	Groundnut stem rot, white mould/ heo ru goc moc trang	+ +
Ralstonia solanacearum	Burkholderiales	Burkhoderiaceae	Bacteria wilt of potato / heo ru tai xanh	+ + +
Peanut stripe virus			Groundnut stripe disease / la kham vang	+ ++
Peanut mottle potyvirus		Potyviridae	Peanut mottle virus / la xoan nhe	+
Major weeds				
Ageratum conyzoides	Asterales	Compositae	Goat weed / co cut lon	+ + +
Amaranthus spinosus	Caryophyllales	Amaranthaceae	Spiny amaranthus /den gai	+ +
Celosia argentea	Caryophyllales	Amaranthaceae	Quailgrass /mong ga	+ +
Cynodon dactylon	Cyperales	Poaceae	Bermuda grass /co chi	+ + +
Cyperus rotundus	Cyperales	Poaceae	Crowsfoot grass /co cu	+ +
Dactyloctenium aegyptium	Cyperales	Poaceae	.. . . . / co chan ga	+ + +
Eclipta prostrata L.	Asterales	Asteraceae	False daisy /co muc	+ +
Eleusine indica	Cyperales	Poaceae	Fowlfoot grass /co man trau	+ + +
Chloris inflata	Cyperales	Poaceae	Plush grass / co luc long	+ +

Note: + + + extremely widespread and serious; + + widespread and serious; + locally serious

Correspondence analysis

The data compaction over range of the cropping practices (categorization of the information) and pest data over time are shown in table 4.

Table 4. Data compaction over ranges: categorization of the information (cropping practices and pests)

Variable	Categories
A	Study site areas: A1: area 1 (Duc Phu, Phong Dien district), A2: area2 (Quang Thai, Quang Dien district) A3: area 3 (Vinh Phu, Phu Vang district)
V	Village: V1: Dien Trung village (Phu Vang district) , V2: Nghia Lap village (Phu Vang district), V3: Duc phu village (Phong Dien district), and V4: Trung Kieu village (Quang Dien district)
DF	Duration of fallow period : DF1: below 3 months DF2: above 3 months and below 4 months DF3: above 4 and below 5 months DF4: above 5 and below 6 months.
LSE	Name of rice variety – Lac sen (wide used variety)
MD7	Name of rice variety – MD7(wide used variety)
L14	Name of rice variety – L14 (wide used variety)
PP	Plant x plant: PP1: 7 cm, PP2: above 7 and below 10 cm, PP3: above 10 and below 15 cm
RR	Row x row: RR1: 17-20 cm, RR2: above 20 and below 27 cm, RR3: above 27 and below 41 cm.
M	Manure application: M1: below 700kg/ha, M2:above 700kg and below 4000 kg/ha, M3: above 4000 and below 7000kg/ha
N	N Fertilizer input: N1: below 30 kg /ha, N2: above 30 and below 50 kg/ha N3: above 50 and below 300 kg/ha
P	P Fertilizer input: P1: 50 – 60 kg/ha , P2: above 60 and below 100 kg/ha, P3: above 100 and below 320 kg/ha
K	K Fertilizer input: K0: no K fertilizer application, K1: below 60 kg/ha K2: above 60 and below 200 kg/ha
NA	Insecticide use frequency: NA1: one pesticide appication, NA2: two applications. NA3: more than three applications
ND	Nutrient deficiency: NDO: none nutrient deficiency, ND1: nutrient efficiency observed at one visit., ND2: nutrient efficiency observed at more than 2 visits.
T1	The first top dress: T11: below 32 kg N,P,K ; T12: above 40 and below 50 kg; T13: above 50 and below 500 kg.
T2	The second top-dress : T21: below 32 kg N,P,K /ha ; T22: above 32 and below 40 kg/ha; T23: above 40 and below 220 kg
T3	The third top-dress: T31: None application, T32: below 60 kg; T33: above 60 and below 120 kg/ha
AP	AP0: No aphids; AP1: area under Aphids population progress curve below 1370 (N.dsu); AP2: above 1370 and below 2480 (N.dsu)
BM	BM0: no blister beetle, BM1: maximum severity below 2.6%; BM2: between 2.7 and 7.7%
LF	LF0: no leaf curling moth, LF1: area under leaf curling moth injury progress curve below 80 N.dsu; LF2: above 80 and below 440 N.dsu.
CW	CW0: no cotton worm, CW1: area under CW population progress curve below 30 N.dsu; CW2: > 30 – 230 N.dsu
BS	BS1: area under early leaf spot severity progress curve above 49 and below 410 (%. dsu) BS2: above 410 and below 730, BS3: above 730 and below 1750 (%. Dsu)
BL	BL1: area under later leaf spot severity progress curve below 63%.dsu; BL2: above 63 and below 310; BL3: above 310 and below 1950
WA	WAO: no weed infestation above the canopy, WA1:area under WA progress curve below 60%. Dsu, WA2: above 60 and below 100
WB	WB1: area under weed below the canopy progress curve below 60, WB2: above 60 and below 100 WB3: above 100 and below 140, W4: above 140.
Y	Y1: Yield 739.2 - 1603 kg/ha; Y2: above 1603 and below 2307 kg/ha; Y3: above 2307 and below 2693 kg/ha; and Y4: above 2693 and below 3660 kg/ha.

Two contingency tables were built: (1) yield across cropping practices (Y x PR) and (2) yield across pest profiles (Y x PE).

The yield across cropping practices contingency (Y x PR) shows the distribution of individuals (fields) according to two categorized variables, the yield profiles (horizontally) associate with a given cropping practice. This contingency table indicates that cropping practices are associated with variation in yields. The total chi-square value associated with the contingency table 11 is 382.249, df= 140, P = 0,00.

Correspondence analysis on the contingency (Y x PE) yields two major axes. The first one accounts for 67.36% of the total inertia, the second for 22.43% (see Fig.3). These two axes account for a large proportion of the total inertia, which needs interpretation. Axis 1 represents the increasing yields, the contribution of extreme yield classes are highest and show a change of sign of the contributions. Axis 1 shows strong contribution of DP3, PP1, PP3, RR3, LSE, N3, K0, K2, T32, T33, NA3, ND1, and ND2. Axis 2 represents very low yield categiries (Y1). On this axis Y1 is associated with RIC, VEG, PP3, K0, NA3, and ND2.

The resulting graph (Fig.3) is a path of moving yields amidst the different categories of cropping practices profiles. With particular reference to cropping practices, the progress from high yield to very low yield is associated with a reduction of inputs and /or a decrease in the management of production factors. The move from Y4 to Y3 corresponds to a decline in fertilizer input (M1) or production factors (NA1, NA2, PP2, L14, LEG, P2, LI1, LI2). The move from Y3 to Y2 corresponds to a decline in fertilizer inputs (M2, N1, K1). The move from Y2 to Y1 corresponds to low fertilizer inputs or poor production factors (NA3, ND2, K0, LIO, M1, MO, ...).

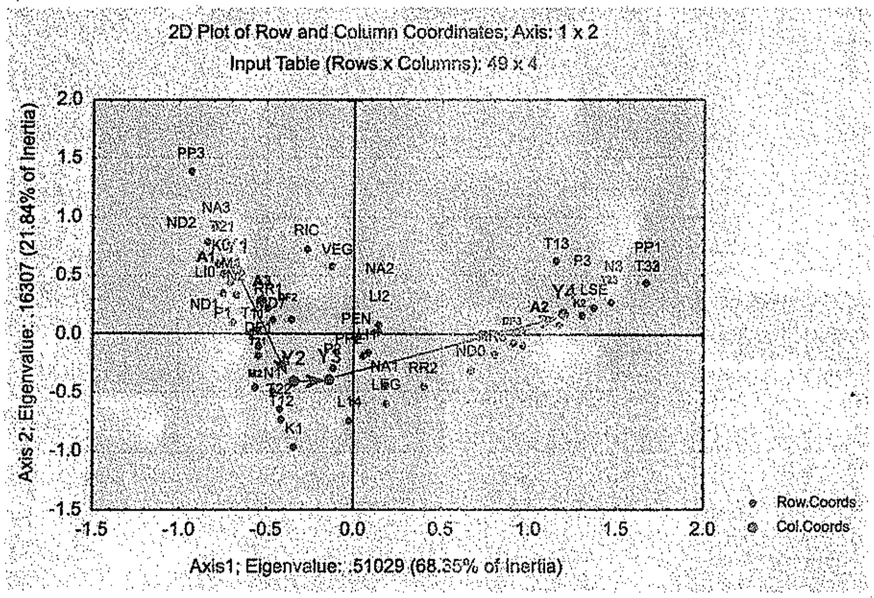

Fig. 3. The path of increasing peanut yields among the different categories of cropping practices

The yield across pest profiles (Y x PE contingency) also shows similar observations. Some pest profiles were frequently associated with low yields (e.g., WA2, WB3, BP3...) . The chi-square value associated with this contingency table is 165.676, df= 78, p = 0.000.

Correspondence analysis on the contingency (Y x PE) yielded two major axes. The first one accounts for 68.35% of the total inertia, the second for 21.84% (see Fig.4). Since these two axes accounted for a large proportion of the total inertia, they were considered for interpretation. Axis 1 represents a gradient of increasing yields, the contribution of extreme yield classes are highest and show a change of sign of the contributions. Axis 1 incorporates strong contribution of WA1, WB3, A2, BMO, BM1, LF2, BS1. Axis 2 represents very low yield (Y1), high yield (Y4), low yield Y2 and medium yield Y3. On this axis, Y2 and Y3 are associated with WA2, LF1, CW1, GS3 while Y1 is associated with A2, LF2, WS3.

The resulting graph (Fig.4.) is a path of increasing yields amidst the different categories of pest profiles. Pest profiles can be associated with yields decline. Very low yield Y1 is associated with pests at the highest level: WB3, LF2, BL3, BS3, BM1, BL2, A2. On the contrary, very high yield (Y5) is associated with a nearly absence of BM0, or with pests at low level: CW1, A1, WA1, BS1, GS2. The move from Y4 to Y3 is associated with LF1, and GS3. The move from Y3 to Y1 is associated with BM2, WB1, BL1, BS2, WB2, BL3, BS3, BM1, BL2, WB3, LF2, and A2.

The analysis suggests some main pest profiles that may contribute to yield reduce. In case of pest controlling, WB3, BL3, BM2, BS3 are the main ones that should be paid much attention to.

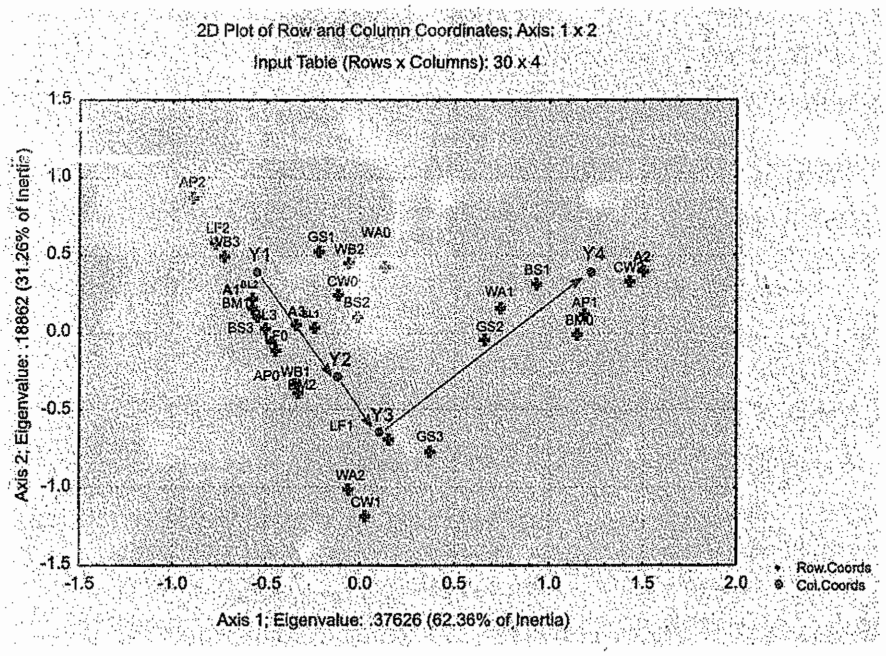

Fig. 4. The path of increasing yields among the different categories of peanut pest profiles

ChilLi crop survey

Major chilli pests on the sandy soil in Thua Thien Hue Province

Among the 7 identified insect pest species, Heliothis armigera, Scirtothrips dorsalis , Myzus persicae, and Aphis gossypii are both serious and widespread. For diseases, there are 7 kinds, of which Phytophthora capsici, Collectotrichum sp., Cucumber mosaic virus, and Rhizoctonia solani are extremely serious and widespread. Among the 9 species of weeds which have been identified, Celosia argentea, Cynodon dactylon, Cyperus rotundus, Dactyloctenium aegyptium, and Eleusine indica are very widespread (table 5).

Table 5. Major chilli pests on the sandy soil in Thua Thien Hue Province

Scientific Name	Order	Family	English/Vietnamese Common Name	Distribution & seriousness
Major insects				
Heliothis armigera	Lepidoptera	Noctuidae	cotton bollworm.../sau xanh, sau duc qua...	+ + +
Scirtothrips dorsalis	Thysanoptera	Thripidae	chili Thrips / bo tri	+ ++
Myzus persicae	Hemiptera	Aphididae	green peach aphids / rep muoi	+++
Aphis gossypii	Hemiptera	Aphididae	cotton aphid / rep muoi	+ ++
Agrotis ipsilon	Lepidoptera	Noctuidae	black cutworm/ sau xam	+
Spodoptera litura	Lepidoptera	Noctuidae	taro caterpillar/sau khoan	+ +
Bactrocera cucurbitae	Diptera	Tephritidae	melon fly/ ruoi duc qua	++
		Major diseases		
Phytophthora capsici	Pythiales	Pythiaceae	stem and fruit rot of Capsicum/ chet ru	+ ++
Ralstonia solanacearum	Burkholderiales	Burkholderiaceae	bacterial wilt of potato/ heo xanh vi khuan	++
Collectotrichum sp.	Phyllachorales	Phyllachoraceae	fruit rot/ than thu	+++
cucumber mosaic virus		Bromoviridae	cucumber mosaic/ benh kham dua chuot	+ + +
Cercospora capsici	Moniliales	Hyphomycetes	frog-eye leafspot of pepper/dom la mat ech	++
Rhizoctonia solani	Ceratobasidiales	Ceratobasidiaceae	root rot/chet eo va thoi re	+++
Sclerotiorum rolfsii			/thoi than (moc trang)	+
Major weeds				
Ageratum conyzoides	Asterales	Compositae	Goat weed / co cut lon	+ +
Amaranthus spinosus	Caryophyllales	Amaranthaceae	Spiny amaranthus /den gai	+ +
Celosia argentea	Caryophyllales	Amaranthaceae	Quailgrass /mong ga	+ ++
Cynodon dactylon	Cyperales	Poaceae	Bermuda grass /co chi	+ + +
Cyperus rotundus	Cyperales	Poaceae	Crowsfoot grass /co cu	+ ++
Dactyloctenium aegyptium	Cyperales	Poaceae	..... / co chan ga	+ + +
Eclipta prostrata L.	Asterales	Asteraceae	False daisy /co muc	+ +
Eleusine indica	Cyperales	Poaceae	Fowlfoot grass /co man trau	+ + +
Chloris inflata	Cyperales	Poaceae	Plush grass / co luc long	+ +

Note:
+ + + very widespread and absolutely serious
+ + widespread and serious
+ locally serious

Correspondence analysis

Table 6 shows the data compaction over range of the cropping practices (categorization of the information) and pest data over time. .

Two contingency tables were built: (1) – yield across cropping practices (Y x PR) and (2) – yield across pest profiles (Y x PE) .

The yield across cropping practices (Y x PR) contingency shows the distribution of individuals (fields) according to two categorized variables. It can be seen that the yield profiles (horizontally) are associated with a given cropping practice. This contingency table indicates that cropping practices are associated with variation in yields. We can recognise the relation of yield profiles and field area. FA1 (8,7,0,and 2 fields) differs from the profile of FA2 (17,18,10,7) and FA3 (0,2,1,14); many fields in FA3 are moderate to high yield, and more fields in FA1 are low to low yields. Similarly, we can see the same result in others. For examples, yield profiles are associated with crop status (CS), Water status ... The chi-square value associated with the contingency table 5 is 314.53, df = 54, P = 0,00.

Table 6. Data compaction over ranges: categorization of the information (cropping practices and pests)

Variable	Categories
FA	Field area : FA1: 200-360 sq.m; FA2: 360-500 sq.m; FA3: 500-1500 sq.m
CS	Crop status : CS1: good; CS2: Bad
CD	Crop density: CD1: below 250 plant/ s.q.m, CD2: >250-320; CD3: >320 – 380
WS	WS1: Wet; WS2: Dry
NB	Number of branches of sq.m: NB1: 20-34; NB2: 34-43.7; NB3: 43.7-51.7
NL	Number of leaves per branch: NL1: 10-17; NL2: 17-20; NL3: 20-26.1
NF	Number of flowers per branch: NF1: 2-4.7; NF2: 4.7-6.1; NF3: 6.1-13.2
FR	Number of fruits per branch: FR1: 2-4.7; FR2: 4.7-8.8; FR3: 8.8-15.5
CW	cotton bollworm : CW0: 0, CW1: 3-70; CW2: >70-345 (N.dsu)
LM	Leaf miner LM0: 0; LM1: 3-168; LM2: >168 1344 (%.dsu)
LF	leaf folder: LF0: 0; LF1: 4-159; LF2: >159-950 (%.dsu)
Ap	Aphids: Ap0: 0; Ap1: 22-276; Ap2: >276-2940 (N.dsu)
CT	Chili thrips: CT0: 0; CT1: 12-144; >144-820 (N.dsu)
LS	Frog-eye Leaf spot: LS0: 0; LS1: 2-174; LS2: >174 – 990 (%.dsu)
BW	Bacterial wilt of potato; BW0: 0; BW1: 2-26; BW2: 26-240 (%.dsu)
CM	Cucumber mosaic; CM0: 0; CM1: 10-150; CM2: >150-1420 (%.dsu)
SF	Shed flowers: SF1: 4-70; SF2: >70-171; SF3: >171-1210 (%.dsu)
NBS	NBS1: area under severity progress curve below 80%.dsu; NBS2: >80-170 %.dsu; NBS3: > 170-960 %.dsu
LB	LB0: No leaf blast; LB1: area under severity progress curve below 190%.dsu; LB2: . 190 – 970 %.dsu
BP	BP1: area Brown plant-hopper population progress curve below 40%.dsu; BP2: >40 – 160%.dsu; BP3: >160 – 920 %.dsu
LF	LF0: no leaf folder; LF1: area under LF injure progress curve below 550 N.dsu; LF2: > 550 – 5300 N.dsu
WA	WAO: no weed infestation above the canopy, WA1: area under WA progress curve below 300%.dsu; WA2: >300- 1400%.dsu
WB	WBO: No weed infestation below the canopy; WB1: area under WB progress curve below 500 %.dsu; WB2: >500 – 2660 %.du
Y (fresh yield)	Y1: Yield 1800-4100 kg/ha; Y2: above 4100 and below 9000 kg/ha; Y3: above 9000 and below 12.700 kg/ha; Y4: above 12.700 and below 20.000 kg/ha

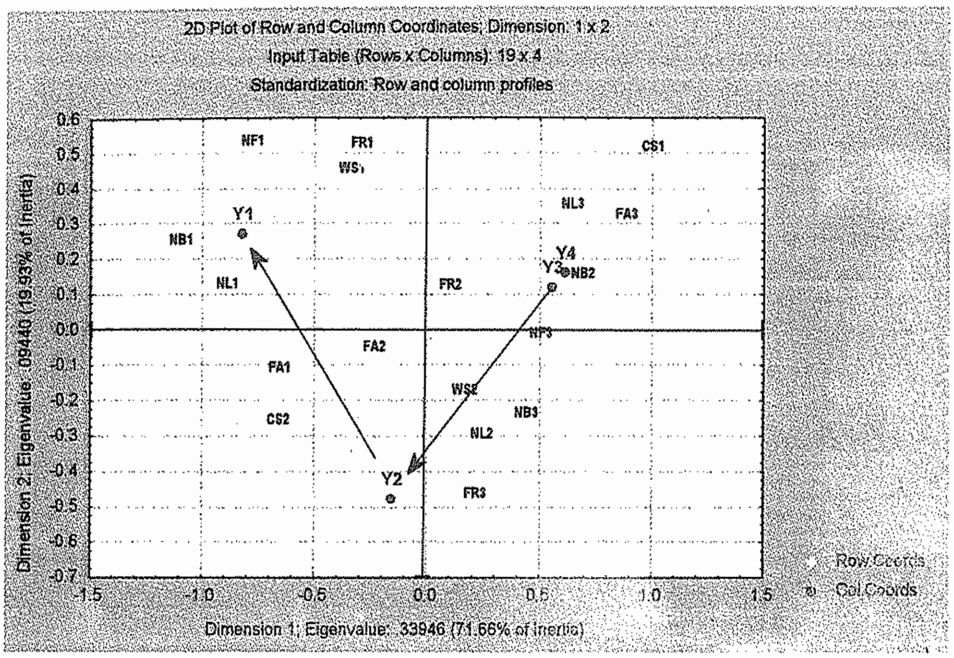

Fig. 6. The path of increasing yields among the different categories of cropping practices

Correspondence analysis on the contingency (Y x PR) yielded two major axes. The first accounts for 71.76% of the total inertia, the second for 19.93% (see Fig. 5). These two axes accounted for a large proportion of the total inertia, which need considering interpretation. Axis 1 represents a gradient of decreasing and increasng yields, the contribution of extreme yield classes is lowest Y1 and medium and high yield Y3 and Y4 and shows a change of sign of the contributions. Axis 1 incorporates FA1, CS2, NB1, NL1, NF1 with Y1. Axis 1 also represents medium yield (Y3) and high yield (Y4). On this axis, Y3 and Y4 are associated with FA3, CS1, NB2, NB3, NL3 and NF3.

The resulting graph (Fig.5) is a path of increasing yields amidst the different categories of cropping practices profiles. When seeing with particular reference to cropping practices, the progress from high yield to very low yield is associated with a reduction of inputs and /or a decrease in the management of production factors. The move from Y4, Y3 to Y2 corresponds to a decline in field area (FA3--> FA2) water input (WS1->W2), NL3 --> NL2, or yield factor (FR3-->FR2, NB2-->NB3, ..). The move from Y2 to Y1 corresponds to a decline in field area (FA2-->FA1, NB2-->NB1, NL1, CS2...,)

The analysis suggests some main factors contributing to yield reduce. The yield Y1 is associated with factors such as: NL1 (Number of leaves per branch), NF1 (Number of flowers per branch, low), FA1 (field area = smal), WS1 (Water status: dry), FR1, (Number of fruits per branch), CS2 (Crop status : Bad). Improvement of these factors might result in even higher yields.

The yield across pest profiles (Y x PE) contingency shows similar observations. Some pest profiles are frequently associated with low yields (e.g., CW2, LM2,...) the table indicates that the variation of yield and pest profiles are not independent. The chi-square value associated with this contingency table is 224.90, df = 96, p = 0.000.

Correspondence analysis on the contingency (Y x PE) yielded two major axes. The first one accounts for 83.11% of the total inertia, the second for 9.54% (see Fig. 6). As these two axes account for a large proportion of the total inertia, they need interpretating. Axis 1 represents a gradient of increasing yields, the contribution of extreme yield classes is highest and shows a change of sign of the contributions. Axis 1 incorporats strong contribution of CW2, LM2, AP2, CT2, ... The resulting graph (Fig. 6) is a path of increasing yields amidst the different categories of pest profiles. Pest profiles can be associated with yields decline. Very low yield is associated with pests affected chili crop at highest levels. At very low yield, Y1, associated with CW2, LM2, AP1, AP2,CT2. On the contrary, high yield (Y4) is associated with a nearly absence of all pests. The move from Y4,Y3 to Y2 is associated with LF1, SF3, CF2, FR2, BW2, AP1, CM1. The move from Y2 to Y1 is associated with LS2, CM2, CT2, AP2, CW2.

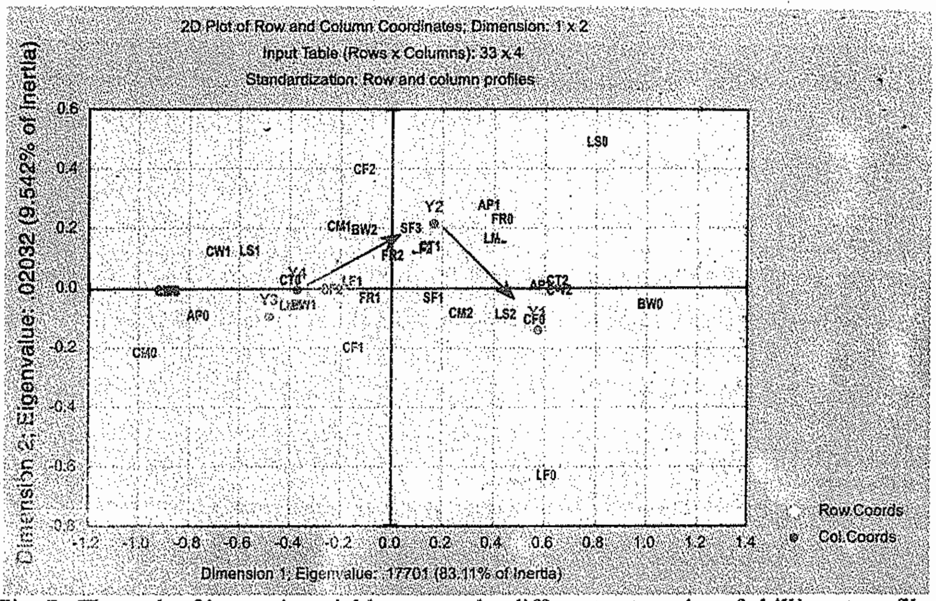

Fig. 7. The path of increasing yields among the different categories of chilli pest profiles

The analysis suggests some main pest profiles that may lead to yield reduce. The first one is associated with the appearance of below canopy weeds , the second is associated with pests such as Frog-eye Leaf spot (LS2), Cucumber mosaic (CM2), Chili thrips (CT2), aphids (AP2), and chili thrips (CT2). Control of these pests might result in even higher yields.

CONCLUSION

Rice crop survey

Table 7. Abiotic and Biotic constraints at 3 areas of Thua Thien Hue, Central Vietnam

Area	Abiotic and abiotic constraints
Area 1 (Coastal area- Phong Hoa commune, Phong Dien distrist)	Yield: Low and Medium yield (Y3) above 5000 and below 5520 kg/ha Biotic constraints: WB1; WB2 (Weed below the canopy) ; WA1 (weed above the canopy); DR1 (white flower); Abiotic constraints: DF1(Duration of fallow period) ; CD1(Crop density) ; P2 (P fertilizer input); N2 (N fertilizer input); M2 (Manure applied) ; KD (Khang dan rice variety)
Area 2 (Coastal area- Quang Thai commune, Quang Dien distrist)	Yield: Very low yield Y1: below 2980 kg/ha Biotic constraints: DE1 (dead heart), LF2 (Leaf folder); BP3 (Brown planthopper); WA2 (Weed above the canopy) ; DR2 (white flower) ; SHB3 (Sheath blight) ; DE1; LB2 (Leaf blast); NBS3 (Narrow brown spot) Abiotic constraints: N1 (N fertilizer input); P1 (P fertilizer input) ; K1(K fertilizer input); NA2 (Pesticide applied at least two time) ; ND1(Nutrient deficiency at least one visit). NP1 (NPK fertilizer applied); DF4 (Duration of fallow);
Area 3 (Coastal area- Vinh Phu commune, Phu Vang distrist)	Yield: Y4 & Y5 high and very high yields: above 5520 and below 6100 kg/ha; Y5: above 6100 kg/ha Biotic constraints: DE1 & DE2 (dead heart) DR0 (No white flower); WB0 (No weed below the canopy); SHB1, SHB2 (Shealth blight); NBS1 (Narrow brown spot); LB0

(No leaf blast); BP2 (Brown planthopper).
Abiotic constraints: DF3 (Duration of fallow) ; X21 (rice variety) ; N3: (N fertilizer input); P3 (P fertilizer input) ; K3 (K fertilizer input); CD3 (crop density); NAO (No Pesticide applied) ; NA1(pesticide applied at least one vitsit) ; ND0 (No nutrient deficiency); M1 (Manure applied)

Peanut crop survey

Table 8. Abiotic and Biotic constraints at 3 areas of Thua Thien Hue, Central Vietnam

Area	Abiotic and abiotic constraints
Area 1 (Coastal area- Phong Hoa commune, Phong Dien distrist)	Yield: very low yield Y1: 739.2 – 1603 kg/ha Biotic constraints: AP2 (aphids) ; LF2 (Leaf folder); WB2 (Weed below the canopy); WB3; BL2; BL3 (Later leaf spot);BS3 (early leaf spot); Abiotic constraints: PP3 (Plant x plant); NA3 (insecticide applied) ; ND1, ND2 (nutrient deficiency) ; T11(the first fertilizer applied - top dress); T21 (second fertilizer- top dress); K0 (No K fertilizer applied); LI0 (no lime applied); N2 (N fertilizer applied) ; M1 (manure applied) ; RR1 (row x row); P1 (P fertilizer applied) ;
Area 2 (Coastal area- QuangThai commune, Quang Dien distrist)	Yield: High yield Y4: above 2693 – 3660 kg/ha Biotic constraints: CW2 (cotton leaf worm) ; AP1(aphid) ; BM0 (no blister beetle); GS2 (Rust); WA1(weed above the canopy) ; BS1 (early leaf spot) Abiotic constraints: T13, T32 (top dress); P3 (P fertilizer applied); PP1 (plant x plant); N3 (N fertilizer applied) ;LSE (peanut variety); K2 (k fertilizer applied) ; RR3 (row x row) ; ND0 (no nutrient deficiency) ; M2 (manure applied)
Area 3 (Coastal area- Vinh Phu commune, Phu Vang distrist)	Yield: Y1 & Y2 : 739.3 - 2307 kg/ha Biotic constraints: WA2 (weed above the canopy) ; BM2 (Blister beetle) ; WB1 (weed below the canopy); AP0 (no aphid) ; BS2 (early leaf spot) ; LF0 (No leaf folder) Abiotic constraints: RIC; RR1; DF1; RR1; N1; T22; T21; K1;M1; T31;MD7; DF2;

Chilli crop survey

Table 9. Abiotic and Biotic constraints at 3 areas of Thua Thien Hue, Central Vietnam

Abiotic and abiotic constraints
Yield: Very low yield Y1: below 4100 kg/ha (fresh fruit) Biotic constraints: Frog-eye Leaf spot (LS2)., Cucumber mosaic (CM2),Chili thrips (CT2), aphids (AP2), and cut wollworm (CW2). Control of these pests might result in even higher yields. Abiotic constraints: NL1 (Number of leaves per branch), NF1 (Number of flowers per branch, low), FA1 (field area = smal) , WS1 (Water status: dry), FR1, (Number of fruits per branch), CS2 (Crop status : Bad)
Yield: Medium yield (Y2) above 4100 and below 9000 kg/ha Biotic constraints: CM1, BW2, FR2, SF3, CT1, LF2, AP1, and FRO Abiotic constraints: CS2, FA2, NL2, NF2
Yield: Y3 & Y4 medium and high yields: above 9000 and below 12700 kg/ha; Y4: above 12700 kg/ha Biotic constraints: CMO, APO, LM1, BW1, CW1, LS1, CWO, CTO, SF2, LF1, FR1 Abiotic constraints: FA3, NL3, CS1, NB2, NF3, NB3, WS2, NB2, FR3

The analysis of pest and cropping practice profiles shows that variation in yields is the outcome of these interacting factors. Very low yields (Y1) are closely associated with pests at higher levels. On the contrary, high yields are associated with an absence or low level pests and with good cropping practices.

1. Biotic constraints: Very low yields (Y1) are closely associated with pests at higher levels. For rice crop the dangerous pests are: DE1 (dead heart), LF2 (Leaf folder); BP3 (Brown planthopper); WA2 (Weed above the canopy) ; DR2 (white flower) ; SHB3 (Sheath blight) ; DE1; LB2 (Leaf blast); and NBS3 (Narrow brown spot). (table 7)

For peanut crop the main pests are: AP2 (aphids) ; LF2 (Leaf folder); WB2, WB3 (Weed below the canopy); BL2; BL3 (Later leaf spot); and BS3 (early leaf spot); (table 8)

For chili crop the most infectious pests are: Frog-eye Leaf spot (LS2)., Cucumber mosaic (CM2),Chili thrips (CT2), aphids (AP2), and cut wollworm (CW2). (table 9)

2. Abiotic constraints: very low yields are associated with poor cropping practices that farmers applied.

For rice crop the poor cropping practices are: N1 (N fertilizer input); P1 (P fertilizer input) ; K1(K fertilizer input); NA2 (Pesticide applied at least two time) ; ND1(Nutrient deficiency at least one visit). NP1 (NPK fertilizer applied); and DF4 (Duration of fallow). (table 7).

For peanut crop the poor cropping practices are: PP3 (Plant x plant); NA3 (insecticide applied) ; ND1, ND2 (nutrient deficiency) ; T11(the first fertilizer applied - top dress); T21 (second fertilizer- top dress); K0 (No K fertilizer applied); LI0 (no lime applied); N2 (N fertilizer applied) ; M1 (manure applied) ; RR1 (row x row); and P1 (P fertilizer applied). (table 8).

For chili crop these poor cropping practices were: NL1 (Number of leaves per branch), NF1 (Number of flowers per branch, low), FA1 (field area = smal) , WS1 (Water status: dry), FR1, (Number of fruits per branch= low), CS2 (Crop status : bad) (table 9).

3. The results show that the experiments are nessasary to measure the impact of these pests on yields loss under specific production situation as well as to assess their management and upgrade process for rice, peanut and chilli production. Information of the survey should be used for making a renovation in cropping practices where farmers applied poor cropping practices so as to build an increasing rice and peanut yields.

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