RESEARCH TRENDS IN INTEGRATED MANAGEMENT OF MAJOR CACAO DISEASES AND FUTURE PROSPECTS IN NIGERIA

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2016 Next Generation Cocoa Research Symposium
Introduction

• *Theobroma cacao* is the most prominent foreign exchange earning crop in West Africa which produces over 70% of the annual total World production.

• In Nigeria, it’s second to petroleum but 1st among Agricultural produces.
Introduction

- Cacao suffers severe losses to pests & diseases (Bartley, 2005)
- Black pod, \( (Phytophthora\ megakarya\ &\ P.\ palmivora) \)
- CSSVD (Cocoa Swollen Shoot Virus)
- Root-knot nematode \( (Meloidogyne\ incognita) \)
Introduction

- *Phytophthora* pod rot is the most important disease of cacao in West Africa. (Bowers *et al.*, 2001).

- 100% pod losses is reported in some areas (PAN 2001, Agbeniyi and Adedeji, 2003).
A typical cocoa pod infected with black pod disease (a=whitish spores of *Phytophthora megakarya*)

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Introduction

- Fungicides spray, the most effective control (Purdy and Schmidt, 1996).
- Regular outbreaks despite fungicides spray (Agbeniyi and Adedeji, 2003).
Introduction

• CSSVD causes decline of cocoa production in Ghana & Nigeria years past (Dongo and Orisajo, 2007)

• 1st noticed in 1935, lead to establishment of (WACRI) West African Cocoa Research Institute(Opeke, 2003)
Ravaging impact CSSVD

• The virulent strains cause various types of leaf chlorosis, root necrosis, swellings on branches and twigs

• With greater development of phloem and xylem, followed by die-back in Nigeria (Dongo and Orisajo, 2007)
Control measures

• To removal of affected plants
• Selection for Tolerant and Resistant hybrids
• Screening of safe pesticides for controlling insect vectors
Ravaging impact of Root-knot Nematode

- Root-knot nematode (*Meloidogyne incognita*) causes yield decrease, sudden death and retardation of seedling growth (Campos & Villain, 2005)
Control measures

• Soil amendment with poultry litters
• Combination of carbofuran and poultry litters
Ravaging impact of major cacao diseases (2)

- The pathogen, CSSV spread from tree to tree
- By mealy bugs, over 8 species transmit the virus
- *Planococcoides njalensis* (Laing) and *Planococcus citri* are the most important mealy bug vectors
- There are many strains of the virus in Nigeria
- And differ in the symptoms they produce
- The virulent strains cause various types of leaf chlorosis, root necrosis, swellings on branches and twigs
- With greater development of phloem and xylem, followed by die-back in Nigeria (Dongo and Orisajo, 2007)
Efficacy of pesticides

- Contact or systemic which are copper, metalaxyl and metalaxyl – M based fungicides
- Have resulted in reduction of incidences of black pod disease & increase cacao production in Nigeria
- Copper hydroxide, Cuprous oxide + metalaxyl-M, Cuprous oxide, Copper hydroxide + metalaxyl and Cuprous hydroxide have been screened by CRIN to test their efficacy on – station and on – farm trials
- Currently being screen are: Pyraclostrinbin (69g) + Dimetomorph (38g), Copper (1) oxide (60%) + metalaxyl 12% and Mandipropamid (125g) + Mefenoxam (100g)
Problems and hazardous effects of pesticides

- Resistance of the pathogen (Fontem et al., 2005)
- Runoff from heavy rainfall and water pollution.
- Abuse by ignorant farmers
- Residual effects
Development and Prospects of IPM for Cacao

- Researches have demonstrated the efficiency of *Trichoderma* strains (Adedeji et al., 2005, 2007 and 2008)
- Studies have also compared the efficacy of BCA – *Trichoderma* strains (NIG-T287, NIG-T288, NIG-T289, NIG-T290 and NIG-T293) along with common active ingredients use on cacao
- Economic viability, improved cacao production.
- Cuprous oxide + metalaxyl, metalaxyl-M, Copper (II) Sulphate Pentahydrate and Copper Hydroxide were tolerated by BCAs *in vitro*
- Field trials along and in combination with the BCAs were demonstrated
EFFECT OF TREATMENTS ON POD YIELD PARAMETERS

*BA = NIG-T287 F2BA = FUNGURAN OH + NIG-T287; BB = NIG-T288 F2BB = FUNGURAN OH + NIG-T288; BC = NIG-T289 F2BC = FUNGURAN OH + NIG-T289; BD = NIG-T290 F2BD = FUNGURAN OH + NIG-T290; BE = NIG-T293 F2BE = FUNGURAN OH + NIG-T293; F1 = RIDOMIL GOLD F3BA = COPPER SULPHATE +NIG-T287; F2 = FUNGURAN OH F3BB = COPPER SULPHATE +NIG-T288; F3 = COPPER SULPHATE F3BC = COPPER SULPHATE +NIG-T289; F1BA = RIDOMIL GOLD + NIG-T287; F3BD = COPPER SULPHATE +NIG-T290; F1BB = RIDOMIL GOLD + NIG-T288 F3BE = COPPER SULPHATE + NIG-T293; F1BC = RIDOMIL GOLD + NIG-T289 CONTROL = UNSPRAYED STANDS; F1BD = RIDOMIL GOLD + NIG-T290; F1BE = RIDOMIL GOLD + NIG-T293. ADEDEJI ET AL., (2010).

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Effects of poultry litter and carbofuran soil amendments on the growth of cacao in the field naturally infested with plant-parasitic nematodes

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height(^1) (cm)</th>
<th>Stem girth(^1) (cm)</th>
<th>Number of Branches(^1)</th>
<th>Number of Leaves(^1)</th>
<th>Leaf area(^1) (cm(^2))</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL at 0.4t/ha</td>
<td>252.3a</td>
<td>4.38a</td>
<td>33.8a</td>
<td>342.8a</td>
<td>246.3a</td>
</tr>
<tr>
<td>PL at 0.4t/ha + C at 2.50kg a.i./ha</td>
<td>252.7a</td>
<td>4.39a</td>
<td>32.3a</td>
<td>341.7a</td>
<td>246.7a</td>
</tr>
<tr>
<td>PL at 0.4t/ha + C at 1.25kg a.i./ha</td>
<td>253.3a</td>
<td>4.39a</td>
<td>32.8a</td>
<td>340.8a</td>
<td>246.3a</td>
</tr>
<tr>
<td>PL at 0.3t/ha</td>
<td>228.7c</td>
<td>3.98c</td>
<td>24.3b</td>
<td>256.3b</td>
<td>224.3b</td>
</tr>
<tr>
<td>PL at 0.3t/ha + C at 2.50kg a.i./ha</td>
<td>234.0b</td>
<td>4.03b</td>
<td>24.3b</td>
<td>257.0b</td>
<td>224.3b</td>
</tr>
<tr>
<td>PL at 0.3t/ha + C at 1.25kg a.i./ha</td>
<td>234.7b</td>
<td>4.05b</td>
<td>25.0b</td>
<td>257.0b</td>
<td>224.7b</td>
</tr>
<tr>
<td>PL at 0.2t/ha</td>
<td>157.0d</td>
<td>3.15d</td>
<td>19.7c</td>
<td>154.0c</td>
<td>143.7c</td>
</tr>
<tr>
<td>PL at 0.2t/ha + C at 2.50kg a.i./ha</td>
<td>155.3d</td>
<td>3.17d</td>
<td>19.7c</td>
<td>152.3c</td>
<td>143.7c</td>
</tr>
<tr>
<td>PL at 0.2t/ha + C at 1.25kg a.i./ha</td>
<td>155.3d</td>
<td>3.12d</td>
<td>19.7c</td>
<td>152.7c</td>
<td>143.3c</td>
</tr>
<tr>
<td>C at 2.50kg a.i./ha</td>
<td>131.7e</td>
<td>2.90e</td>
<td>12.0d</td>
<td>105.0d</td>
<td>120.3d</td>
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<tr>
<td>C at 1.25kg a.i./ha</td>
<td>101.3f</td>
<td>2.10f</td>
<td>6.8e</td>
<td>67.3e</td>
<td>91.7e</td>
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<tr>
<td>Control</td>
<td>79.7g</td>
<td>1.81g</td>
<td>4.3f</td>
<td>44.0f</td>
<td>66.7f</td>
</tr>
</tbody>
</table>
Figure 4: Dieback conditions of cacao seedlings in the field caused by plant-parasitic nematodes 8 weeks after transplanting (A) compared to plant in plot amended with poultry litter (B)
Figure 5: Sudden death of cacao seedlings in the field caused by plant-parasitic nematodes 12 weeks after transplanting (A) compared to plant in plot amended with poultry litter (B)
Managing Cocoa Diseases Using Cultural Practices

• Cultural practices are simple to apply both for cost and environmental conservation
• Phytosanitation is an important cultural method
• Complete removal of diseased plants/parts of the tree
Future research and policy to enhance integrated management of cacao diseases

- Hybridization of strains of *Trichoderma* is required to combine beneficial characteristics
- Mass production of BCAs and formulation into pellets
- Field trials of new active ingredients in combination with BCAs
- Molecular characterization of *Phytophthora*, *Trichoderma* and Nematode species in growing regions of Nigeria
- Development of IPM package botanical species, BCAs & pesticides against cacao diseases
Future research and policy to enhance integrated management of cacao diseases

- Development of bio-pesticides to combat cacao diseases
- Production of Tricho-composts and formulations for cacao nursery and field diseases
- Breeding for more disease resistant varieties of cacao
- Development of curriculum in cocoa phytomedicine for faculty of Agricultures and Colleges of Agriculture to be packaged and run by Universities and CRIN
- Provision of enabling environment & encouragement for research on cocoa
- As an important foreign earning crop for West Africa
Conclusion

• Integrated cocoa disease management stresses reliance on preventive practices
• And balances the strengths of one practice against the weaknesses of another
• To provide a more complete or holistic disease management approach
• Responsible pesticides usage is advocated only if the preventive practices fail
• IPM reduces concern about pesticide residue and contamination of cocoa beans
• There will be access to safe and quality cocoa for the production of chocolate.
Thanks for your attention