Integrated Management of Insects, Diseases and Weeds

Solution Holder is **Boaz Waswa** and can be contacted through **b.waswa@cgiar.org**

Summary

Common bean is susceptible to diverse pests and diseases that strongly impact on its productivity. At the same time, inappropriate pesticide use may cause health and environmental risks and result in resistance of pests. For instance, use of chemical substances to control pests like beetles, aphids, cutworms, leaf spots, crown rots and common grassy or broadleaf weeds poses selective pressure on these organisms that leads to the emergence of biotypes that are resistant to those pesticides. Failure to address this issue results in food insecurity and loss of income as well as distorting natural control mechanisms. Integrated pest management (IPM) is based upon diverse biological, mechanical, physical and cultural methods that bring about effective and longer lasting crop protection without posing dangers to food safety and the environment.

Technical Description

IPM aims to harness natural control mechanisms for pests and use chemical pesticide substances as little as possible. The primary focus is maintaining a well-balanced population of beneficial organisms based on current knowledge of their life cycles and interactions with the environment. IPM strategies involve carefully selected mixes of biological, mechanical, physical and cultural techniques. A wide range of biological measures can be used that directly affect the target pest such as releases of natural predators and enemies, or sterile insects that dilute breeding populations. Increasing the abundance of beneficial communities or introducing new species must be done cautiously to avoid detrimental impacts on non-target organisms. Mechanical and physical interventions involve equipment that deter or disturb pests. Cultural measures avoid accumulation of pest and weeds and include practices such as precision sowing, shifting planting dates, removing residues of diseased plants, establishing plant strips that shelter predators, deployment of pheromone traps, and reliance upon pest-resistant varieties. IPM can suppress multiple threats such as aphids which transmit diseases like bean common mosaic virus.

Uses

Effective IPM strategies are available for many important pests of common beans, including aphids, mites, maggots and cutworms, diseases like anthracnose, white mold

and bacterial blight, and weeds like wild oats, sedges and pigweed. The principles of IPM can be implemented across different soil types and climatic conditions. Mechanical, physical and cultural techniques may match a very broad set of agronomic and environmental conditions, and can be easily modified to local contexts. Biological techniques suit a narrower range of geographies that is delimited by the physiological traits of beneficial organisms and the composition and management of native communities.

Composition

Release of beneficial control agents follows two basic approaches; ‘inoculative’ where a limited number of advantageous organisms are introduced and accumulate up over time, or ‘inundative’ where massive rearing leads to the dispersal of large numbers of organisms. The inoculative technique is suitable for long term interventions, whereas the inundative technique immediately results in suppression of pests that counteract severe outbreaks. Natural predators and enemies can be enhanced by providing alternative nesting and feeding sites. The sterile insect method effectively decreases reproduction rates of pests by releasing infertile males. The cultural practices for managing pests in common bean include use of early maturing and disease resistant bean varieties, clean seed and irrigation water that is free from insects, diseases and weed seeds, rotation with non-host crops, mulching, and adjusted row spacing and planting times. Increasing crop density and decreasing row spacing is effective to suppress the growth of weeds and their seed banks. IPM minimizes the application of chemical substances to control pests by methods like seed coating and pre-emergent herbicides.

Means of application

Implementing IPM strategies begins with identifying the type and number of harmful and beneficial organisms on a farm, and establishing critical thresholds in the community structure when economic injury to common bean take place. Monitoring pests is performed using simple tools such as traps and handheld magnifying glasses, or with advanced high resolution cameras fitted onto drones that allow rapid surveillance of large areas. Inspections of weeds is performed between emergence and canopy closure, and again post-harvest to avoid carry-over. Insect and disease surveys are conducted simultaneously and must be repeated at different growth stage from emergence through early flowering and pod filling. Software tools and participation in specialized social media offer means to track and identify pests and natural enemies, and refine IPM strategies. Once the threshold population of harmful organisms is reached then prescribed actions are taken, a strategy very different than precautionary spraying with agro-chemicals.

Agroecologies	Moist savanna, Highlands, Dryland area.
Regions	Africa South of Sahara.

Developed in Countries	Benin, Kenya, Zimbabwe, Ivory Coast, Senegal, Malawi, Uganda, Democratic Republic of the Congo, Rwanda, Mozambique, Tanzania, Togo, South Sudan, Nigeria, Ghana, Ethiopia, Central African Republic, Cameroon, Burundi.
Available in	Benin, Kenya, Zimbabwe, Ivory Coast, Senegal, Malawi, Uganda, Democratic Republic of the Congo, Rwanda, Mozambique, Tanzania, Togo, South Sudan, Nigeria, Ghana, Ethiopia, Central African Republic, Cameroon, Burundi.
Solution Forms	Management.
Solution Applications	Insect control, Disease control, Weed control.
Agricultural Commodities	Common bean.
Target Beneficiaries	Small-scale farmers, Commercial farmers, Women, Youth, Agro-dealers.

Commercialization

Commercialization Category

Commercially available

Startup Requirements

Farmers can adopt IPM solutions after: 1) Identifying the full range of pests and beneficial organisms that counteract them, 2) Defining management strategies in comparison to conventional practice, 3) Understanding the benefits for pest control and production costs in the short- and longer-term, and 4) Accessing control agents such as reared predators and bio-pesticides agents and seeking advise on how best to use them.

Production Costs

Detailed surveillance of pests and their natural enemies for implementing IPM strategies requires specialized skills best provided by public agencies. For example, rearing colonies of parasitoid wasps requires inexpensive materials and planned releases across large areas requires only US $5,000 to install and a further US $6,000 per year to operate. Cultural measures to control pests slightly increase the workloads of farmers. Coating seed costs between US $0.50 and $1 per kilogram for strategic placement of

insecticide and fungicide. Use of pre-emergence herbicides requires as little as US $25 to $35 per hectare.

Customer Segmentation

Biological, mechanical and cultural techniques for IPM in common bean are intended for small-scale and commercial farmers, with products, equipment and use advisory being delivered by agro-input suppliers, local services providers and agricultural extension.

Potential Profitability

Proactively managing the use of synthetic pesticide agents by implementing IPM-based control measures avoids outbreaks and large production losses when pests become resistant. The design of IPM strategies must be performed in a way that the cost and labor requirement of control techniques is lower than the economic damage to bean yields without taking those measures.

Licensing Requirements

Permits from national plant health agencies are needed for the rearing and release of biocontrol technology. Intellectual property related the composition of fungicides and insecticides for seed treatment, and herbicides for weed control are commercially owned.

Innovation as Public Good

Biological, mechanical and cultural measures included under IPM strategies are developed as a Regional Public Good. The development and scaling of chemical control measures is done primarily by private companies, often in collaboration with regulatory authorities and research institutes.

Solution Images

Severe attack of black bean aphids

Hoverfly larva feeding on aphids

Institutions

Accompanying Solutions

Mechanical and Chemical Weed Management

Seed dressing of Seed with Fungicide and Insecticide