Analysis of the Activity of Natural Biopesticides on Different Plant Varieties

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ABSTRACT: Agriculture has become high investing and low yielding due to uncontrolled use of synthetic chemicals that are harmful to ecosystems. To protect our biosphere, organic farming replaces harmful chemicals with bio-fertilizers and bio-pesticides. This process maintains soil fertility. Biopesticides can support the life of soil organisms and can generate high crop yields. This project formulated biopesticides from milk as well as a combination of chili, garlic, and decayed vegetables and fruits. These components were applied to spinach, Brinjal, and tomato plants. The methods provided rapid plant growth and action against pests. The results are promising for future biopesticide development that should be further researched.

KEYWORDS: Biopesticides; Milk; Chili; Garlic; Tomato; Spinach; Brinjal.

Introduction. The earliest agricultural biocontrols were plant extracts. For example, nicotine was used to control plum beetles as early as the 17th century. Experiments involving biological controls for agricultural pests date back to 1835, when entomologist Agostino Bassi demonstrated that white-muscadine fungus (Beauveria bassiana) causes an infectious disease in silkworm. Experiments with mineral oils as plant protectants were also reported in the 19th century. The 20th century saw a rapid institutional expansion of agricultural research and, with it, an ever-growing number of studies and proposal for biocontrols.[1]

Biopesticides generally display an erratic performance under field conditions and hence represent a small percentage of the global crop protection market in the performance of microbial insecticides including Baculoviruses which is compromised due to its sensitivity to desiccation and ultraviolet light. Therefore, successful implementation of a pest control program involving Baculoviruses depends upon several factors, beginning with a detailed understanding of host–parasite biology and disease dynamics. A major factor in biocontrols is the selection of the most virulent isolate of the virus for an insect pest in a given geographical location. Isolates differ in their insecticidal phenotypes and a study has identified genes in SeMNPV that are likely involved in the pathogenicity and virulence of OBs.[1] Biopesticides generally possess several advantages over conventional pesticides. A serious health hazard for chemical pesticides is the presence of pesticide residues in food. Other risks include developed resistance in the targeted pest populations and a decrease in biodiversity. An advantage of microbial pesticides is that they replicate in their target hosts and persist in the environment due to horizontal and vertical transmission which may cause long-term suppression of pest populations even without repeated application.[2]

The increased social pressure to replace synthetic pesticides with other alternatives that are safe to humans and non-target organisms has led to increased development of compounds. Biopesticides include an array of microbial pesticides and biochemicals derived from microorganisms, photochemical and other natural sources, and processes involved in the genetic modification of plants to express genes encoding insecticidal toxins.[3] Biological compounds are used to control pests, pathogens, and weeds by a variety of means. Microbial biocontrols may include a pathogen or parasite that infects the target.[3] They often act as competitors or inducers of plant host resistance. Biochemical controls can also act through inhibiting the growth, feeding, development or reproduction of a pest or pathogen. Other biocontrols form a barrier on the host to act as a feeding or infection inhibitor through a multifunctional approach.[3]

Biopesticides are usually applied similarly to chemical pesticides. With all pest management products, especially microbial agents, effective control requires appropriate formulation and application.

Biochemical biopesticides are naturally occurring compounds and are characterized by a nontoxic mode of action that may affect the growth and development of a pest, its ability to reproduce, or pest ecology. The growth and development of treated plants, including their post-harvest physiology, is deeply dependent on the activity of application of biopesticides.[2]

Results and Discussion. The treatment using all of the aforementioned methods was found to be very effective. In the initial phase, the plants were categorized and marked, then divided into different groups. All groups were exposed to the different varieties of treatment.

DOI:10.36838/v2i2.8

Table 1. Analysis of the application of different fertilizer combinations in different stages of growth of Brinjal.

Protein	Gene	Coverage	#peptides	# amino acids	MW (kDa)	Predicted protein function
Outer membrane protein A	OMP A	40.17	8	346	37.2	Adhesin/invasin; binds GlcNAc1,4-GlcNAc epitopes on glycoprotein. Target for immune system
Outer membrane protein X	OMP X	13.45	2	171	18.6	Adhesion and invasion of lung epithelial cells
Outer membrane protein slp	OMP slp	9.57	1	188	20.9	Initial adhesion. Binds to human polymeric immunoglobulin receptor
Flagellin	Flagellin	56.75	21	585	59.9	Motility. Target for immune attack

Table 2. Analysis of the application of different fertilizer combinations in different stages of growth of Tomato.

Trial	Crop Stage	Duration (days)	Fertilizer Type	Fertilizer Effect
1	Plant establishment	10	Chili & garlic	effective
	Vegetative	26	Chili & garlic	effective
	Flower insertion to first picking	40	Chili & garlic	effective
	Harvesting	50	Chili & garlic	effective
2	Plant establishment	10	From milk	effective
	Vegetative	30	From milk	effective
	Flower	40	From milk	effective
	Harvesting	46	From milk	effective
3	Plant establishment	10	Decayed vegetables and fruits	effective
	Vegetative	30	Decayed vegetables and fruits	effective
	Flower insertion to first pick up	38	Decayed vegetables and fruits	effective
	Harvesting	42	Decayed vegetables and fruits	effective

Table 3. Analysis of the application of different fertilizer combinations in different stages of growth of spinach.

Trial	Crop Stage	Duration (days)	Fertilizer Type	Fertilizer Effect
1	Plant establishment	3	Chili & garlic	effective
	Vegetative	5	Chili & garlic	effective
	Flower insertion to first picking	7	Chili & garlic	effective
	Harvesting	9	Chili & garlic	effective
2	Plant establishment	3	From milk	effective
	Vegetative	6	From milk	effective
	Flower	8	From milk	effective
	Harvesting	10	From milk	effective
3	Plant establishment	2	Decayed vegetables and fruits	effective
	Vegetative	4	Decayed vegetables and fruits	effective
	Flower insertion to first pick up	5	Decayed vegetables and fruits	effective
	Harvesting	8	Decayed vegetables and fruits	effective

The plants were all grown simultaneously. The experiments have remarkable results. Using chili and garlic with brinjal was found to be the most effective treatment out of all the crops. The treatment decayed vegetables and fruits protected tomatoes and spinach from pest attacks.

Brinjal was the first crop subjected to our field studies. The chili and garlic combination was found to be the most effective as it promoted the establishment of the plant within 10 days and achieved remarkable growth and harvest within 69 days. The Brinjal treated with milk-based fertilizer produces a similar effect. Its flower stage is within 30 days and harvest occurred at 75 days. The fertilizer made from decayed vegetables and fruits is a variation of the conventional practices and presented growth duration to the harvesting stage at 70 days, shown in Table 1.

Tomato was the second crop tested with the different fertilizers. The tomato plant took 50 days to reach the harvesting stage when treated with chili and garlic. Milk-based fertilizer and decayed fruits and vegetables treatments allowed harvest at 46 days and 42 days, respectively, as shown in Table 2.

Spinach was the third crop to be tested. Spinach was harvested within 8 days with the decayed fruits and vegetables treatment. When milk-based fertilizer was used, harvest occurred within 9 days occurred.

Conclusion. The results observed using the three biofertilizer treatments showed that the fertilizer made from chili and garlic was the most effective when used on brinjal. The normal time duration for brinjal crop to be harvested is between 90 – 110 days. This was significantly reduced to 69 days by the addition of chili and garlic biofertilizer. The decayed vegetables and fruits were found to be more effective for both spinach and tomatoes. For tomatoes, the normal time duration of 50 – 60 days was reduced to 42 days due to the biofertilizer made from leafy vegetables and fruits. Spinach, usually harvested at 10 – 12 days was harvested within 8 days through the application our biofertilizer made from leafy vegetables and fruits.

Biopesticides and biofertilizers can help farmers transition from toxic conventional chemical pesticides to an era of truly sustainable agriculture. Questions remain regarding the safety of biopesticide products for both human and ecosystem health. Green chemistry is about continuous improvement aimed to reduce or eliminate health hazards. We must encourage pest management solutions and regulations to continuously evolve. It must also be ensured that multi-disciplinary teams including green chemists, environmental specialists, and other researchers approach these novel innovations more holistically.

Methods.Selection of the Plant Varieties. Brinjal, tomato, and spinach seeds were collected from the seed purchasing center Krishi Bhavan from Alleppey, Kerala, India. The seeds were initially dried in sun and then used for further experiments.

Growth of the Plant Varieties. Spinach seeds were sprinkled with a small amount of water and then tied in muslin cloth until germination. The seeds were then planted in soil. Brinjal and tomato seeds were planted in sandy soil.

Fertilizer Using Chili and Garlic. To make the fertilizer, ½ cup of chopped hot pepper and ½ cup of chopped garlic were combined in a blender to make a thick paste. The paste was added

to ½ liter of warm water. The solution was kept for 24 hours and then strained to remove the solid vegetable pieces. The collected liquid was used as biofertilizer.

Fertilizer from Milk. To make the fertilizer, ½ liter of milk was poured into a vessel. Juice from ½ a lemon was added and mixed well and left for one day. The product was sieved into another vessel. The liquid obtained is a source of calcium, minerals and potassium. Water was added to ensure an equal ratio of milk to water.

Fertilizer from Leafy Vegetables and Fruits. Grated coconut along was tied onto a cotton cloth. 500mL fermented curd was added into a mud pot and coconut water was added. The vegetables were tied with edges of cotton cloth and kept dipped for five days in the mud pot. Water was added to the mixture.

Acknowledgements. We would like to express our heartfelt gratitude to our biology teacher, Dr. Anoop, for constantly looking out for opportunities and platforms for us to present this project. We also express our deepest gratitude to Mrs. Jayakumari. They have both been a source of inspiration and encouragement to us. We would also like to thank Dr. Meena Shukoor, our beloved principal for constant motivation and providing us the freedom to perform the field trials on campus as well as permitting us to use our school laboratory.

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Authors. A. K. Ashkay is a studious student who enjoys discovering new things. He is hardworking and always striving to reach new heights.

Dayajanaki possesses creative ideas on various experimental approaches which helped her create such a beautiful idea of biopesticides. She intends to pursue her higher studies in the engineering fields.

DOI: 10.36838/v2i2.8