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Study the efficacy of biopesticides for protecting maize fields against the Blended Leaf and Sheath Blight disease induced by *Rhizoctonia solani* spp. in Ranchi, Jharkhand

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Abstract- Every year farmers face 10-40 percent grain yield loss on maize cultivation, Maize is one of the important crops that consume low water, highly nutritious, fast-producing crops. Blended leaf and Sheath blight is a serious disease caused by a soil-born fungus *Rhizoctonia solani*, multi nuclei septate hyphae, branched, white, and dark brown colonial fungus, affect leaves, stalk, and ears. Irregular water-soaked straw colour spot on leaf sheath and dark brown stalk. Artificially inoculated BLSB on Maize field at Dr. Shyama Prasad Mukherjee University's campus area, Seeds were purchased from Birsa Agriculture University, Ranchi. Invasive plant leaves and green stem parts are boiled for six hours and collect their extracted solution. Total seven treatments were designed, four biopesticide treatment were provided individually (T1, T2, T3, T4) including a control - T7 and a chemical pesticide treatment -T5 and T6 only inoculated with infection. Spry thrice a week and compare their infection rate. T2 treatment shows the best result, T4 is better than T1, T3 and T5 shows more or less similar effects and T6 infected plot without treatment showing massive loss of productivity.

Keywords: Maize, Biopesticide, BLSB, Pesticide, *Rhizoctonia solani*

INTRODUCTION

Since 1000 BC pesticides have been used in agricultural practices, Sulphur, Arsenic, and Mercury were use as biopesticides at those days, in the year of 1901 Japanese scientist Shigetane Ishiwatari discovered a toxin protein which lethal for specific larvae but not to others, considered the first initiation steps for introducing biopesticides through experiments. This discovery opens a door to producing biopesticides from bacteria, fungi, viruses and protozoa. Pheromone, IGRs, and PIPs also contribute positive results as biopesticides. Secondary metabolite ailanthone released by *Ailanthus altissima* inhibits seed germination and root growth of other plants. Catechin from *Centaurea stoebe* is a competitive chemical for its surroundings. Secondary metabolites: Steroids, flavonoids, resin have been found antifungal, antibacterial, antioxidant and insecticidal properties.[1] High humidity, frequent irrigation or rainfall and 25ºC -30ºC is the most favourable condition for *Rhizoctonia solani* f. sp. Sasakii, a necrotrophic fungus can infect any stage of growing maize plant but damaging during flowering to fruiting stages. Balodi *et al.* (2023)[2] in the year of 2023 treated chitosan in different concentration and found 57.5% growth inhibation with 1 mg/ml chitosan. Sclerotia of *R.solani* can survive two years in the soil. *Rhizoctonia solani* have both anamorphic and telomorphic stages, telomorphic phase known as *Thanatephorus cucumeris*. Sclerotia of *R.solani* can survive in unfavorabe conditions like high temperature,

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low temperature and against any chemical substance, initial it colour is light but gradually changes into dark brown. Akbar & Fang (1945)[3] mention in his research paper four types sclerotia loose, terminal, lateral chained and lateral simple are mentioned. initially, Corn was cultivated by Native people of southern Mexico gradually spread 58º N latitude in Canada, Russia to 40ºS latitude in South America. Karnataka, Maharashtra, Madhya Pradesh, Rajasthan, Uttar Pradesh, Bihar, Jharkhand, Telangana, Andhra Pradesh states of India cultivate Maize crops during the summer season (end week of March - mid-July), 500-800 mm rainfall, well-drained loamy soil with pH level of 5.5-7.5 is favourable for maize plant. Land ploughing, proper levelling of soil surface with spacing approx. 60cm × 20cm is required for maize cultivation, showing single seeds into a 4-5 cm depth, waterlogging sensitivity causes root diseases, so small channels between rows with proper slope besides the lower part of the plants. Hexaconazole is used at the early infected stage, Propiconazole dose 1.0 L dissolved within 500 L per hectare sprayed, while BLSB symptoms appear,

MATERIALS & METHODS

Inoculating stage: PDA Media, Test tubes, Laminar Air Flow, Hot Air Oven, Autoclave, Lamp, inoculation loop.

Field Area: Grape hoe, Sprayer, Hand trowel, Grass shears, Pick-Mattock, Axe, Pipe, Bucket, Measurement Tape, Stick- with Scale.

Infection culture tubes of BLSB were collected from Birsa Agriculture University's Plant Pathology Department and Birsa Makka-1 seeds were purchased from Birsa Agriculture university's Plant Breeding and Genetics Department.

Seven Plot was designed with RBD inside the campus area of Dr. Shyama Prasad Mukherjee University, Back side ground of the botany departments. Each plot covered 9 inches × 9 inches area, consists four replicas with twenty-fives plants. Each replica maintained 75 cm distances from other. Total five rows maintain approx. 45-50 cm distance from each other and 25-30 cm gap between two plants in each row. Seeds were ploughing during March. Temperature require 21ºC to 27ºC and Rainfall min 50-100cm to 250-400 cm. before ploughing the seeds soil irrigate properly, remove all stones and pebbles, levelling the soil surface area. Weeds ate remove weekly, after one to two weeks seeds are germinated and plants of maize emerged from the soil. Prepare multiple culture tubes from collected BLSB culture inside Botany and Microbiology laboratory of Dr. Shyama Prasad Mukherjee University. Hyphal growth was observed within one weeks, when proper amount infection culture tubes are collected its applied on the field of maize plants.

Disease inoculation: Infection were inoculated before the flowering stage come, during the evening after sunset and in the morning before sunrise after seven days its repeated again for proper inoculate infection on plants infection inoculated within two methods, 1- Infection were taken from 2-3 test tube for each replica, culture dilute with water and by the help of bunch of cotton bud rub infection on plants leaf, stem and all parts respectively. 2- Infection were taken from 15 test tubes it dilutes with its PDA media within a bucket of water, by the help of a sterilized rod mixed it properly then spread on all experimental field except the control field. Control field established separately very far from the main experimental field.

After one weak BLSB symptoms were going to show, irregular water soaked like spots were occur on leaves, and stems gradually its colour turn into brown, with the help of measuring scale, infection spots were measured and ranking them based on infection occurring rate percentage through using of Formula = (Infection Area- Uninfected Area)/ Total Area×100

Table 1- Measurement of infection through Horsfall - Barratt Scale with plant condition.

Rating	% of infection	Degree of Infections
1	0	No symptoms
2	1-3	Some small lesions appear on one sheath
3	3-6	Large lesions appear on one to two sheaths
4	6-12	Many lesions on two sheaths
5	25-50	Disease spread in all sheath except two internodes below the ear
6	50-75	Disease appears on the ears, kernel production normal
7	75-87	Ears size small than the normal, bleaching leaves
8	87-94	Sheath blending and cracking, fungal growth increase
9	94-97	Unshaped ears, wet rot stems, no kernels,
11	97-100	Small size ear without kernel, damping stem wet a
12	100	Dead plants

Fig.1 Blended leaf and Sheath Blight disease of Maize, Infected Sheath, Ears and Kernels.

Invasive Plants leaves & twigs were collected from field *Lantana* sp., *Parthenium* sp., *Ipomoea* sp. All are washed properly through water, soaked all them in water within different container for 6 hr. then boil for 6 hr. each species respectively. A very strong odour with dark greenish- brownish solution come out, all solutions were collected inside containers after cooling. There total seven treatments were established T1- Maize Field treated with *Lantana camara* extracted biopesticide, T2 - Maize field treated with *Ipomoea* sp. Biopesticide, T3-Maize field treated with *Parthenium* sp. Extracted Biopesticides, T4-Maize field treated with Combine of All Biopesticides, T5-Maize field treated with Chemical pesticides, T6- Maize field with Infection without applying any pesticides and T7- Control. Each Treatments Contain Four Replicas; each replica contain 5 rows and 5 maize plants in each row.

Applied biopesticides after inoculation with initially symptoms appeared. During morning before sunrise and in the evening after the sunset pesticides are sprayed for work effectively. Two days weekly.

Table 2 - Rate of plant infection.

TREATMENTS	R1	R2	R3	R4	MEAN	SD
T1	4.739	4.74	4.738	4.737	4.7385	±0.0011
T2	1.393	1.4	1.396	1.397	1.3965	±0.0025
T3	5.399	5.41	5.398	5.398	5.40125	±0.0050
T4	4.173	4.171	4.169	4.171	4.171	±0.0014
T5	5.199	5.198	5.2	5.21	5.20175	±0.0048
T6	9.527	9.529	9.531	9.528	9.52875	±0.0014
T7	0.652	0.652	0.651	0.654	0.65225	±0.0010

Table 3 - Percentage of Stem Infection

TREATMENTS	R1	R2	R3	R4	MEAN	SD
T1	47.24	47.29	47.25	47.26	47.26	±0.018
T2	7.12	7.14	7.16	7.16	7.145	±0.016
T3	53.28	53.22	53.26	53.26	53.25	±0.021
T4	41.74	41.76	41.74	41.77	41.75	±0.012
T5	50.16	50.14	50.16	50.11	50.14	±0.020
T6	97.66	97.65	97.62	97.66	97.64	±0.016
T7	2.56	2.52	2.52	2.55	2.537	±0.017

Table 4 - Percentage of Kernels and Grains infection.

TREATMENTS	R1	R2	R3	R4	MEAN	SD
T1	39.91	39.92	40.01	39.98	39.95	±0.044
T2	3.12	3.11	3.17	3.15	3.137	±0.026
T3	41.92	42.05	41.98	41.96	41.97	±0.053
T4	37.15	37.15	36.98	37.21	37.00	±0.021
T5	42.99	43.08	43.05	42.98	43.02	±0.037
T6	98.06	97.98	97.97	98.02	98.00	±0.040
T7	1.256	1.243	1.251	1.249	1.249	±0.005

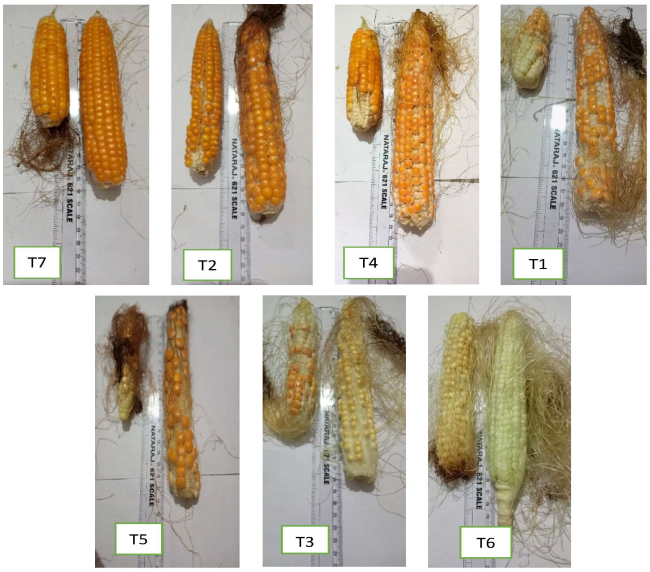

Fig. 2- Kernel and Ears infections rate with biopesticides treatments. T7: Control, T2: Treatment with *Ipomoea carnea* extraction, T4: Treatment with Combine Biopesticides, T1: Treatment with *Lantana camara* extraction, T5: Treatment with Chemical Pesticides, T3: Treatment with *Parthenium* sp. extraction, T6: Treated with only Infection. (Arranged according to infection level)

Fig. 3- Line Graph of table 2, Infection Rate of BLSB in Maize sp. T1-Treated with *Lantana* sp. Extraction, T2- Treated with *Ipomoea* sp. Extraction, T3- Treated with *Parthenium* sp. Extraction, T4- Treated with all combination, T5- Treated with Chemical Pesticides, T6- Only infections, T7- Control.

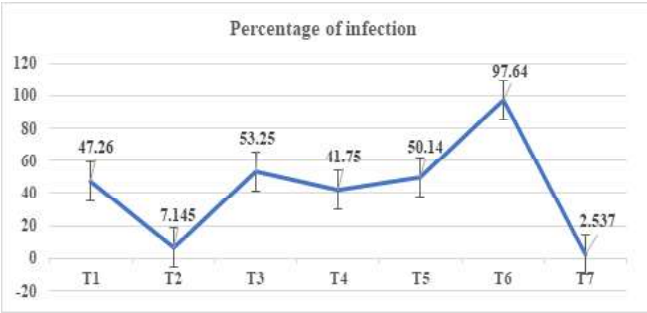

Fig. 4- Line Graph of table 3, Infection percentage about Node and internodal area of BLSB in Maize sp. T1-Treated with *Lantana* sp. Extraction, T2- Treated with *Ipomoea* sp. Extraction, T3- Treated with *Parthenium* sp. Extraction, T4- Treated with all combination, T5- Treated with Chemical Pesticides, T6- Only infections, T7- Control.

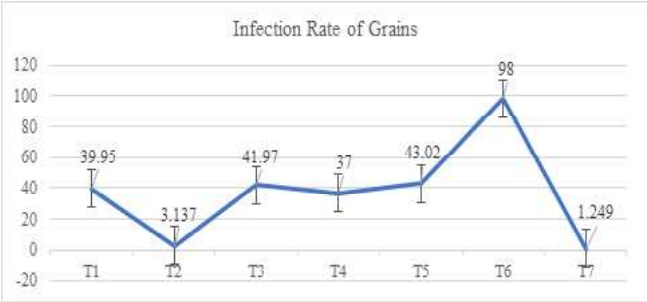

Fig. 5- Line Graph of Table 4, Grains infection percentage of BLSB in Maize sp. T1-Treated with *Lantana* sp. Extraction, T2- Treated with *Ipomoea* sp. Extraction, T3- Treated with *Parthenium* sp. Extraction, T4- Treated with all combination, T5- Treated with Chemical Pesticides, T6- Only infections, T7- Control.

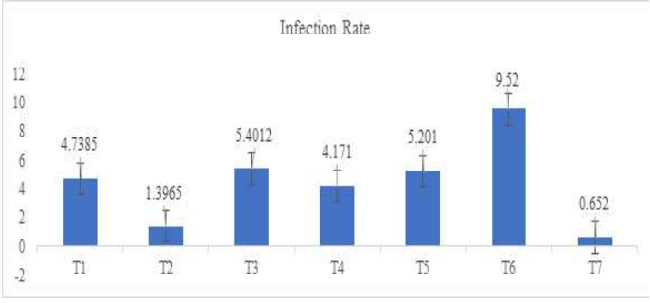

Fig. 6- Column Graph of Table 2, Infection Rate of BLSB in Maize sp. T1-Treated with *Lantana* sp. Extraction, T2- Treated with *Ipomoea* sp. Extraction, T3- Treated with *Parthenium* sp. Extraction, T4- Treated with all combination, T5- Treated with Chemical Pesticides, T6- Only infections, T7- Control.

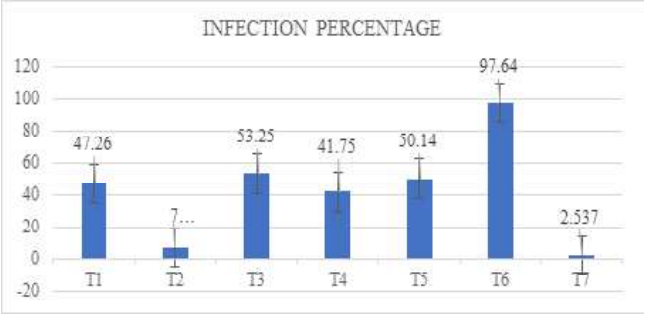

Fig. 7- Column Graph of table 3, Infection percentage about Node and internodal area of BLSB in Maize sp. T1-Treated with *Lantana* sp. Extraction, T2- Treated with *Ipomoea* sp. Extraction, T3- Treated with *Parthenium* sp. Extraction, T4- Treated with all combination, T5- Treated with Chemical Pesticides, T6- Only infections, T7- Control.

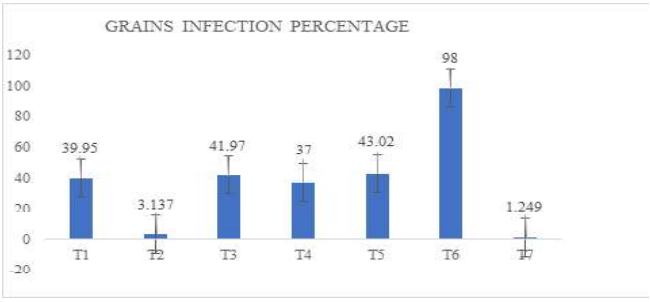

Fig. 8- Column Graph of Table 4, Grains infection percentage of BLSB in Maize sp. T1-Treated with *Lantana* sp. Extraction, T2- Treated with *Ipomoea* sp. Extraction, T3- Treated with *Parthenium* sp. Extraction, T4- Treated with all combination, T5- Treated with Chemical Pesticides, T6- Only infections, T7- Control

DISCUSSION

Total seven treatments, of them Treatment -2 biopesticides made up with *Ipomoea* sp. Shows effective result, infection occur very low percentage after the control. Treatment 4, Mixing of all invasive extract also very effective than chemical pesticides (T5). Treatment-1 biopesticides made up with *Lantana camara* protect the crops from infection more than 50% and in the last category extraction of invasive plant parthenium, Treatment 3 and Chemical Pesticide (T5) both had more or less same effect, Chemical treatments little bit powerful then *Parthenium* plant extraction. According to their infection preventing power T-2 (Extraction of *Ipomoea*) > T-4 (Mixed Extraction of *Parthenium* sp.+*Ipomoea* sp.+*Lantana* sp.)> T-1 (Extraction of *Lantana*) > T-5 (Chemical Pesticide) > T-3 (Extraction of *Parthenium* sp.) > T-6 (Infection without any treatments). Control (without any inoculation) plants infected with pathogen 2.537% and Grains infection 1.249 %. T2 plot of Maize Plant infected with 7.145% infection where Grains infection occurred 3.137%. T4 plot plant's infection rate 41.75% and grains loss 37%, T5 (chemical biopesticides) save crops approx. 60% after inoculated the pathogen and T3 (parthenium extracted biopesticide) showing the more or less same result, grains infection of T5 and T3 were 43.02%, 41.97% plant infection 50.14%, 53.25% respectively. Huge loss in T6 (only infected) plot plants destroyed by 97.64% and grains spoil by 98%. T6 data shows high level of harmful effect through *Rhizoctonia solani* pathogen. So, *Ipomoea* sp. extracted is best to use as biopesticide, its effectiveness is very high rather than other invasive plants, *Lantana* and *Parthenium* extraction also works against pathogens but its effect same as chemical pesticide.

CONCLUSION

Pesticides can cause acute and chronic diseases to human health, headaches, nausea, skin and eye irritation, vomiting, dizziness like acute diseases sometimes cancer, parkinson's disease, infertility also happening by pesticidal effects, Women suffer from miscarriage, hormonal imbalance, irregular periods, and early menopause, Babies are born with mental and physical defect, development delay. Fifteen different types of biopesticides have been developed by ICAR. Bayer CropScience (Germany), Syngenta (Switzerland), BASF (Germany), Corteva Agriscience (USA), and UPL Ltd. (India) are the largest pesticide companies, and also formulate some natural pesticides. In 2017 at Yavatmal of Maharashtra, 50 farmers died, 100 were hospitalised while spraying pesticides on cotton fields, Endosulfan tragedy of Kerala, 2011, forced the Supreme Court to ban that pesticide.1984 Bhopal Gas Tragedy happened for using methyl isocyanate for making pesticides. Chemical pesticides are silent killer for us and other organisms but Indian population also a big challenge for so total removal of chemical pesticides on farming is not practically possible although we can shift our habitat from chemical to natural. Plants protect themselves from host attacks like insects, Bacteria, Pathogens, Viruses, Herbivores through their secondary metabolites, so there is a way to use that alkaloids, terpenoids and other chemicals against crop pathogens. Invasive plants have amazing adaptability and resistance capability against any kind of host and environmental condition. By using its capability in future biopesticide market could capture the full percentage for the beneficiaries of our world and environment. Public awareness, Governmental support, more over education of farmers are must be needed for future generation of India. These experiments give a positive response regarding using of invasive plants as biopesticide, all invasive plants contain effective chemicals which can be used to protect crops

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