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Effect of rhizobium, alone and in combination with neem product against early blight *Alternaria solani* (Ell & Mart*)* disease of potato on economics

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Abstract
The present investigation entitled "Effect of Rhizobium, alone and incombination with Neem Product against Early Blight *Alternaria solani* (Ell & Mart) disease of Potato" was conducted at the Experimental field of the Dept. of Plant Pathology, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad. The experiment was carried out on plot basis in Randomized Block Design with 8 treatments and 3 replications. Leaves were collected in a clean polythene bag and brought to the laboratory from infected potato plant having characteristic symptoms of disease. The PDA medium was prepared and the infected leaf was transferred into the medium. The slide was then prepared from the culture using lactophenol and cotton blue and observed under microscope to confirm the presence of *Alternaria solani* (Ell & Mart). But from the farmer's point of view, the economics of disease management is important. In the present investigation cost benefit ratio was worked out, all the treatments were economically good compared with control but the most economical treatment was Neem oil (1:1.99) cost benefit ratio Neem seed kernel extract (1:1.68), Neem leaf extract (1:1.99), Neem cake (1:1.86), Neem bark (1:1.87) and Rhizobium produced (1:1.68) as compared to treated control Carbendazim (1:2.21) and untreated control (1:1.49).

Keywords: Early blight and potato

Introduction
Neem, *Azadirachta indica* commonly known as neem, is native of India and naturalized in most of tropical and subtropical countries are of great medicinal value and distributed wide spread in the world. Every part of neem tree have been known to possess a wide range of pharmacological properties, especially as antibacterial, antifungal, antiulcer, antifeedant, repellent, pesticide, inhibitor and sterilant and is thus commercially exploitable, and hence, traditionally used to treat large number of diseases. This eco-friendly native tree of India is perhaps most researched tree in the world. Fungal diseases of crop plants have always been one of the major constraints in successful crop production which causes severe yield loss every year.

Indiscreet use of synthetic fungicides for controlling plant diseases have given rise to negative effects on human and animal health and agro-ecosystem. However, the researchers are confident in developing alternatives to chemical fungicides. Eco-friendly systems involving plant products and biological agents, which act directly on the pathogens or indirectly by inducing resistance in plants have gained considerable importance as an alternative to synthetic fungicides. Plant extracts have exclusive antimicrobial properties, which act in holistic mode. So the neem (*Azardirachta indica.* A. Juss.), contains at least 35 biologically active principles of which nimbin and azadirachtin are the most active insecticidal ingredients and are present mostly in the seeds, leaves and other parts of the neem tree. (Sonalkar *et al.,* 2014) [3]

The Neem (*Azadirachta indica)* treatments significantly reduced the early blight disease severity as well as increased the plant height number of branches and yield of potato compared to the infected control under field conditions, Thus the present study revealed that plant extracts have shown significant inhibition and proved to be cost effective and eco-friendly for the management of *A. solani* and were comparable with fungicides. (Ariafar and Zacharia, 2016) [2]

Material and Methods
Economics (Rs)
Cost of cultivation for each treatment was worked out separately gross return (Rs ha^{-1}) was obtained by converting the harvest in to monetary terms at the prevailing market rate during the course of investigation.

Net return was obtained by deducting cost of cultivation from gross return. The benefit: cost ratio was calculated with the help of following formula (Reddy *et al*., 2004).

Benefit cost ratio = Gross return / Net return

Results and Discussion

Effect of treatments on cost: benefit ratio

The data on Cost benefit ratio of potato are furnished in table 4.16. The yields among the treatment were significant. Among all the treatments the maximum yield was recorded in was T3 - Neem oil (228.33), T4 - Neem Leaf Extract (213.33), T7 - Neem seed kernel Extract (226.11), T5 – Neem cake (215.55), T6 - Neem Bark (212.78), T1–Rhizobium (198.33) as compared to treated control T2 - Carbendazim (253.09) and untreated Control T0 - (168.88).

When cost benefit ratio was worked out, all the treatments were economically good compared with control but the most economical treatment was Neem oil (1:1.99) cost benefit ratio Neem seed kernel extract *(*1:1.68), Neem leaf extract (1:1.99), Neem cake (1:1.86), Neem bark (1:1.87) and Rhizobium produced (1:2.14) as compared to treated control Carbendazim (treated control) (1:2.21) and untreated control (1:1.4).

Table 1: Effect of treatments on cost: benefit ratio

Tr. No.	Treatments	Yield qt/ha	Cost of yield Rs/qt	Total cost of yield (Rs)	Common cost (Rs)	Treatment Cost (Rs)	Total cost (Rs)	B:C Ratio
T0	Control	168.88	800	135104	90000	600	90600	1:1.49
T1	Rhizobium	198.33	800	158664	90000	4350	94350	1:1.68
T2	Carbendazim	253.09	800	202472	90000	1400	91400	1:2.21
T3	Neem oil	228.33	800	182664	90000	1560	91560	1:1.99
T4	Neem leaf Extract	213.33	800	170664	90000	600	90600	1:1.95
T5	Neem cake	215.55	800	172440	90000	2600	92600	1:1.86
T6	Neem bark	212.78	800	170224	90000	600	90600	1:1.87
T7	NSKE	226.11	800	180888	90000	1560	91500	1:1.97

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