

Original Research Article

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Eco-friendly Management of Rust of Field Pea (*Pisum sativum* L.)

S. Mounika Reddy*, Indarapu Madhuri and Shashi Tiwari

Department of Plant Pathology, Sam Higginbottom University of Agriculture Technology and Sciences Prayagraj, Uttar Pradesh, India

*Corresponding author

ABSTRACT

Keywords

Essential oils, Neem oil, Pea, *Trichoderma viride*, Clove oil, Castor oil, Rust

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An experiment was conducted at Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh in *Rabi* season of 2019-20. A field experiment was conducted in RBD to evaluate different essential oils, one bio-agent and their combinations to control rust disease of pea and also to increase the plant growth parameters. During evaluation, all the seven treatments viz. Neem oil (5%), Castor oil (5%), Clove oil (5%), *Trichoderma viride* (5%), *T. viride* + Neem oil (2.5%+2.5%), *T. viride*+ Castor oil (2.5%+2.5%) and *T. viride*+ Clove oil (2.5%+2.5%) were found to be significantly superior over control in managing the rust disease and also in increasing the growth parameters. Among the treatments T₅- *T. viride* + Neem oil (2.5%+2.5%) followed by T₁-Neem oil (5%) and T₄ - *Trichoderma viride* (5%) were significantly superior over other treatments in managing rust disease of the crop and also in increasing the growth parameters. During evaluation, *Trichoderma viride* at 2.5% in combination with neem oil at 2.5% was found as best treatment to control rust disease and also to increase the growth parameters.

Introduction

Pea (*Pisum sativum* L.) is a valuable vegetable as well as pulse crop all over the world, is also known as 'Matar'. It belongs to the family Leguminosae and a self-pollinated crop (Anonymous, 2004).

Globally, pea is grown in an area of 1.2 million ha with total production of 9.3 million tonnes and the productivity is 8.42 tonnes/ ha. India is the second largest pea producing country and shares 21 percent production of world. In India, it occupies 5.43 lakh hectare area with annual production around 54.32

lakh metric tonnes and productivity of 46.51 lakh metric tonnes (Indian Horticulture Database, 2017-2018). It is cultivated mainly in Uttar Pradesh and it alone produces 60.78% more than half of the total production of pea. Besides this, Madhya Pradesh, Jharkhand, Punjab, West Bengal, Haryana, Bihar, and Himachal Pradesh are also major pea producing states (Subrahmanyam and Gaganana, 2000) where it is grown for both vegetable and pulse purpose and is a highly remunerative crop (Singh, 2005).

Pea is cultivated for the fresh green seeds, tender green pods, dried seeds and foliage and

cooked as a vegetable, marketed fresh canned and frozen. Dry peas are used as whole, spilt as dal, roasted, boiled and made into flour (Davies *et al.*, 1985).

Among the fungal diseases rust caused by *Uromycesfabae* is the major disease of pea and cause severe damage and which is responsible to reduction in yield throughout the world. Yield reduction due to this disease is very high within short period of time. It is macrocyclicautoecious rust (Singh and Tripathi, 2004). The average yield of pea is quite low as compared to its yield potential. They cause about 30-40% loss annually (Singh, 1999; Upadhyay and Singh, 1994).

Materials and Methods

The effective essential oils, one bio-agent and their combinations were evaluated under field condition. Field experiments were laid-out in Randomized Block Design with three

replications at research plot of the Department of Plant Protection, Sam Higginbottom Institute of Agriculture Technology and Sciences, Allahabad during the *Rabi* season of 2019-20.

The seed variety AP-3 were sown @ 20-25 kg/ha by dibbling method with spacing of 30 cm between row to row and 10 cm between plant to plant by placing 2 seeds per hill at depth of 4 cm. Sowing was done on 20th of December. Yield - kg/plot.

Seed treatment was done by taking pea seeds in separate conical flasks and then essential oils viz. Neem oil, Castor oil, Clove oil and one bio-agent viz. *Trichoderma viride* were taken at 5% concentration accordingly and poured. For combinations oil and *T. viride* were taken 5% each. The flasks were shaken by hand for 5minutes until the seeds were saturated. In control, seeds were planted with no treatment (Hashem *et al.*, 2010).

Treatment No.	Treatment Name	Concentration %
T ₀	Control	-
T ₁	Neem oil	5%
T ₂	Castor oil	5%
T ₃	Clove oil	5%
T ₄	<i>Trichoderma viride</i>	5%
T ₅	<i>T. viride</i> + Neem oil	2.5%+2.5%
T ₆	<i>T. viride</i> + Castor oil	2.5%+2.5%
T ₇	<i>T. viride</i> + Clove oil	2.5%+2.5%

Disease intensity for rust

Observations on rust disease intensity were recorded on randomly selected plants from the each bottom, middle and top leaves. The disease intensity was recorded on pea plant at 30 days, 60 days and 90 days after seed treatment. Five plants in each plot were

tagged and disease intensity for field pea rust was calculated by the formula as employed by wheeler (1969). Data was subjected to ANOVA test.

$$\text{Disease intensity (\%)} = \frac{\text{Sum of all disease rating}}{\text{Total number of leaves} \times \text{maximum grade}} \times 100$$

Results and Discussion

Effect of treatments on plant growth parameters of field pea at different intervals

The readings for plant growth parameters include height, no. of leaves, number of branches were taken on 30, 60 and 90 DAS. The essential oils have some antifungal properties, so the treatments showed their

action in the in vivo experiment. The experiment showed that T₅ *T. viride* +Neem oil gave the best result in turns of height, no. of leaves, maximum number of branches followed by T₁neem oil. At 90 DAS, the data showed maximum height of 85.38cm, 64.17 no. of leaves and 3.36 branches in T₅ treatment followed by T₁-height of 83.17cm, 56.32 no. of leaves and 3.31branches and T₆-height of 81.28 cm, 53.70 no. of leaves and 3.27 branches.

Table.1 Effect of treatments on per cent disease index of rust on field pea at different intervals

Treatment name		PDI (%)		
		30 DAS	60 DAS	90 DAS
Control	T ₀	24.35	54.25	69.13
Neem oil	T ₁	19.84	26.66	34.25
Castor oil	T ₂	24.15	38.08	44.54
Clove oil	T ₃	22.42	35.78	41.56
<i>Trichoderma viride</i>	T ₄	19.87	28.27	35.52
<i>T. viride</i> +Neem oil	T ₅	19.82	25.57	27.77
<i>T. viride</i> + Castor oil	T ₆	20.18	33.43	40.86
<i>T. viride</i> +Clove oil	T ₇	19.91	30.42	38.46
F test		S	S	S
CD(0.05)		0.07	1.04	0.96
SEd(±)		0.45	0.48	0.45

Table.2 Economics of treatments

Treatment details	Yield/ha (q/ha)	Market Value (Rs/q)	Total income (Rs)	Cost of production (Rs)	Net return (Rs)	C:B ratio
Control	11.55	4000	46200	27500	18700	1: 1.38
Neem oil	19.14	4000	76560	28400	48160	1: 2.69
Castor oil	14.03	4000	56120	28700	27420	1: 1.95
Clove oil	16.03	4000	64120	29000	35120	1: 2.21
<i>Trichoderma viride</i>	18.72	4000	74880	28500	46360	1: 2.62
<i>T. viride</i> + neem oil	20.07	4000	80280	28450	51830	1: 2.82
<i>T. viride</i> +castor oil	17.49	4000	69960	28600	41360	1: 2.44
<i>T. viride</i> +clove oil	18.02	4000	72080	28800	43280	1:2.50

Effect of treatments on disease intensity (%) of rust (*Uromyces fabae*) on field pea at different intervals

The data for disease intensity was also taken with growth parameters at 30, 60 and 90 DAS and furnished in Table 1.

The data of 30 DAS showed the minimum disease intensity in the treatment T₅ *T. viride* + Neem oil (19.82%) followed by the treatment T₁ Neem oil (19.84%) and T₄ *Trichoderma viride* (19.87%), where T₀ Control had the maximum disease intensity (24.35%).

The data of 60 DAS showed the minimum disease intensity in the treatment T₅ *T. viride*+Neem oil (25.57%) followed by the treatment T₁Neem oil (26.66%) and T₄ *Trichoderma viride* (28.27%), where T₀ Control had the maximum disease intensity (54.25%).

The data of 90 DAS showed the minimum disease intensity in the treatment T₅ *T. viride* + Neem oil (27.77%) followed by the treatment T₁Neem oil (34.25%) and T₄ *Trichoderma viride* (35.78%) where T₀ Control had the maximum disease intensity (69.13%).

Similar findings were reported by Sughaet *al.*, (1999), Mathur and Gurjar (2002), Ononkoba (2002) and Ahmed and Shaheen (2016). They evaluated the efficacy of *Trichoderma viride* alone and in combination with essential oils against pea rust disease intensity of field pea (*Pisumsativum* L.) in field condition. Minimum disease intensity (%) was found in *Trichoderma viride* in combination with neem oil. The probable reason for such finding may be their inhibitory effects on rust development appeared to be due to production of antibiotic metabolites that inhibited spore germination and formation of rust pustules. The secondary

metabolites such as alkaloids, phenolics and terpenoids of neem oil also inhibit the growth of the pathogen.

Economics of treatments

The data on cost benefit ratio of field pea are furnished in table 2.

The yields among the treatment were significant. Among all the treatments the maximum yield (q/ha) was recorded in T₅- *T. viride*+ neem oil (20.07) followed by T₁-Neem oil (19.14), T₄ -*Trichoderma viride* (18.72), T₇- *T. viride*+ Clove oil (18.02), T₆ - *T. viride*+ Castor oil (17.49), T₃- Clove oil(16.03) and T₂- Castor oil (14.03) as compared to T₀ -control (11.55).When cost benefit ratio was worked out, interesting result was achieved. From the cost benefit ratio it was concluded that most effective treatment was T₅- treatment *T. viride*+ neem oil (1:2.82) followed by T₁- Neem oil (1:2.69), T₄ -*Trichoderma viride* (1:2.62), T₇- *T. viride*+ Clove oil (1:2.50) and least effective treatment was T₂- Castor oil (1:1.95). However all treatments were superior to the control with respect to the cost benefit ratio in managing rust disease.

From present study, it was concluded that *T. viride* (2.5%) + Neem Oil (2.5%) was found as best treatment for the increase in growth parameters of field pea crop. This treatment is also effective in the control of rust disease caused by *Uromyces fabae*. From cost benefit ratio also this treatment was found as most economic method over control. Since chemicals have many hazardous effects on the environment as well as the person who handles it while application in the field, *Trichoderma viride* + Neem Oil would be considered as better as it is eco-friendly. Since one year data is not sufficient to conclude concurrent results, further experimentations are required to confirm the results.

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