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Evaluation of neem oil against powdery mildew (*Erysiphe polygoni* DC) of green gram (*Vigna radiata* L.)

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Abstract
The study was conducted during the *Zaid* season 2023 at the Central Research Field, Department of Plant Pathology, SHUATS, Prayagraj, U.P. Powdery mildew of green gram is caused by *Erysiphe polygoni* DC. It is one of the major constraints in the production and most troublesome foliar disease affecting all aerial portions of plants. Seven different treatments are applied as foliar spray *viz*, Neem oil @ 0.5%, neem oil @ 1.0%, neem oil @ 1.5%, neem oil @ 2.0%, neem oil @ 2.5%, carbendazim @ 0.1% and along with untreated check were evaluated against the powdery mildew. All the treatments were found to significantly reduce the severity of the disease and increase yield. Among all the treatments neem oil @ 2.0% were significantly superior over the other treatments in reducing powdery mildew intensity and also increasing, yield and highest cost benefit ratio, as compared to treated check carbendazim @ 0.1% and untreated check control.

Keywords: Cost benefit ratio, *Erysiphe polygoni* DC, Foliar spray, Green gram, Neem oil, powdery mildew

Introduction
Green gram [*Vigna radiata* (L.) R. Wilczek] belongs to the family Leguminosae and sub family Papilionaceae. It is an excellent source of high-quality protein (25%) having high digestibility. It being a leguminous crop has capacity to fix the atmospheric nitrogen (30-40 kg N/ha). It also helps in preventing soil erosion. Being a short duration crop, it fits well in many intensive crop rotations (https://kvk.icar.gov.in).

The average production of mungbeans is 721 kg/ha, and there are around 7.3 million hectares planted worldwide. 30% of the 5.3 million tonnes of production produced globally is split between India and Myanmar (AICRPR 2022-23).

Powdery mildew of green gram is one of the major constraints in the production particularly late *Kharif* season caused by fungal pathogen *Erysiphe polygoni* DC is most troublesome foliar disease affecting all aerial portions of plants. In India the disease is present in almost all states of the country and becomes severe in dry season. (Khandappagol and Rangaiah, 2019) [4]. Symptoms are white powdery growth: Look for white, powdery patches on the upper and lower surfaces of leaves, stems, and pods. These patches may start small and round, eventually merging to cover larger areas. Leaf distortion: Infected leaves may become yellowed, stunted, and curled. In severe cases, they may even drop prematurely. Reduced pod formation: Powdery mildew can hinder pod development, leading to fewer and smaller pods, ultimately impacting yield (https://krishisevakendra.in).

Yield losses from powdery mildew was reported 35% from Gujarat, western India, 20-40% from Chhattisgarh, central-eastern India and 20-40% in Maharashtra, western-central India, and from 9 to 50% in Uttarakhand and Uttar Pradesh of Northern India also reported 100% loss from Maharashtra State, India due to powdery mildew diseases at seedling stage (Pandey *et al*., 2018) [11].

Neem oil is used as fungicide, to prevent the germination of fungal spores. The neem-based products are used as natural bio fungicide. It consists of chemical compound terpanoid called Azadirachtin and flavonoid called nimbin (Kumar, 2020) [7]. Neem oil can exhibit phytotoxic effects on plants when applied at concentrations higher than 2- 3%.

According to the University of Florida's Institute of Food and Agricultural Sciences (UF/IFAS).

Materials and Methods

The present study was conducted at the experimental field of Department of Plant Pathology in Central Research Field, Sam Higginbottom University of Agriculture, Technology and Sciences, during the *Zaid* season of 2023. Field experiment was laid-out in Randomized block design with three replications. Green gram crop variety PDM- 139 (Samrat) was sown in second week of April with spacing of 30 cm and 10 cm between rows and plants, adopted in plot in plot size of 2x1m^2, respectively. Generally, powdery mildew disease appered at 35-40 days after sowing. Observations on powdery mildew disease intensity were recorded on randomly selected five plants of upper, middle and lower leaves from per plot. The powdery mildew was graded on the basis of disease intensity observed on the leaves by applying 0- 9 disease rating scale developed by (Mayee and Datar, 1986) [8] as described below.

The disease severity of powdery mildew was recorded before spray, seven days after firsy spray and seven days after second spray using 0- 9 rating scale and percent disease index (PDI) was calculated using the formula given by Wheeler (1969) [16].

$$PDI = \frac{\text{Sum of all disease ratings}}{\text{Total number of leaves observed x Maximum disease rating}} \text{ x } 100$$

Application of neem oil spray solution

The neem oil spray solution of desired concentration as the desired concentration as per the treatment is added to 1 litre of water and stirred well. To this emulsifier is added (1ml/ 1 litre). It is very essential to add the emulsifier and mix properly. This should be used immediately before the oil droplets start floating.

Statical analysis

The data obtained from the field experiment were statistically analysed by following the standard procedures (Fisher and Yates, 1968) [3]. In the experiment Randomized Block Design (RBD) was adopted. The analysis of variance (ANOVA) technique was applied for drawing conclusion from data. The calculated values were compared the tabulated values at 5% level of probability for the appropriate degree of freedom.

Results and Discussion

A field study was carried out to assess on various aspects of powdery mildew of green gram caused by *Erysiphe polygoni* DC with reference to evaluation of disease intensity (%) on leaves, number of leaves, number of pods, seed yield (q/ha) and cost benefit ratio among the treatments.

The results of the field experiment presented in table no. 1 two clearly indicate that the disease intensity was significantly low in all the treated plots compared to the unsprayed control plot after two sprays. Disease intensity was recorded three times before spray, seven days after first spray and seven days after second spray of neem oil, respectively. The first spray of neem oil treatment was applied at 40 days after sowing and the second was given at 47 days after sowing an interval of 7 days. Among the treatments the significant reduction in the disease intensity (%) at 40, 47, 55 DAS was recorded in the treatments. The minimum disease intensity (%) of green gram was recorded in T_4- Neem oil @ 2.0% (8.70, 18.04, 27.68) followed by T_2- Neem oil @ 1.0% (10.13, 18.66, 29.17) as compared to other treatments including T_0- untreated control.

The maximum number of pods was observed in T_4- Neem oil @ 2% (12.40) followed by T_2- Neem oil @ 1.0% (11.80), as compared to other treatments including T_0- untreated control. The significant increase in yield was obtained in the treatments, T_4- Neem oil @ 1.0% (7.55 q/ha) followed by T_2- Neem oil @ 1.0% (7.12 q/ha) as compared to other treatments including T_0- untreated control.

From cost benefit ratio neem oil @ 2.0% was statistically found as most economic method over control. While treated check also showed significantly effective for the checking of disease intensity (PDI) and other parameters over control in the field.

Table 1: Effect of treatments on percent disease intensity of powdery mildew on green gram at different time intervals.

Treatment number	Treatments	Percent disease intensity				No. of pods	Yield (q/ha)	B:C ratio
		40 DAS (Before spray)	47 DAS (After 1st spary)	55 DAS (After 2nd spray)	Mean			
T_0	Untreated control	9.34	25.18	37.94	24.15	9.80	4.48	1:1.60
T_1	Neem oil @ 0.5%	9.74	22.20	34.90	22.28	10.80	5.55	1:1.95
T_2	Neem oil @ 1.0%	10.13	18.66	29.17	19.32	11.80	7.12	1:2.46
T_3	Neem oil @ 1.5%	9.32	18.52	28.91	18.92	11.80	7.22	1:2.46
T_4	Neem oil @ 2.0%	8.70	18.04	27.68	18.14	12.40	7.55	1:2.54
T_5	Neem oil @ 2.5%	9.65	17.54	26.94	18.04	12.73	7.62	1:2.52
T_6	Carbendazim (treated check)	9.40	15.77	23.34	16.17	14.60	8.00	1:2.68
SEd(+/-)		0.62	0.31	0.40		0.23	0.17	
C.D (5%)		_____	0.69	0.86		0.50	0.37	

The probable reasons for such findings may be because of inhibitory effect of neem oil which can significantly increase the growth parameters by lowering down the disease intensity by inhibiting pathogen. Due to presence of active ingredients such as sulphur compounds, azadirachtin and nimbidin. Neem oil as foliar spray has shown antifungal properties and inhibited the conidia germination and grem tube length as such recorded minimum percent disease intensity in the management of powdery mildew. Similar findings have been reported by Singh and Singh (1982) [4], Raghuchander *et al*. (2000) [12], Rettinassababady *et al*. (2000) [13], Moharam and Ali (2012) [10], Mishra *et al*. (2017) [9] and Dinesh *et al*. (2015) [2].

Conclusion

From the above experimental findings, it can be concluded that the treatment neem oil @ 2.0% as foliar spray recorded minimum disease intensity (%) of powdery mildew (*Erysiphe polygoni* DC) of green gram (*Vigna radiata* L.) and maximum number of leaves, number of pods, yield (q/ha) and cost benefit ratio. The present investigation is limited to one crop season (April, 2023 - June, 2023) under Prayagraj agro-climatic conditions, therefore to substantiate the present results more such trials are required in future to validate the findings.

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